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Ontario Forestry, Bureau of

REPORT

ON THE

NECESSITY OF PRESERVING AND REPLANTING FORESTS.

COMPILED AT THE INSTANCE OF THE GOVERNMENT OF ONTARIO,

BY

R. W. PHIPPS, TORONTO.

(Clerk of Forestry)

Bound with Annual report ... 1884-1891.

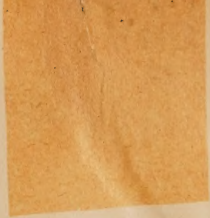


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To the Honourable S. C. Wood,
Treasurer of Ontario,

SIR,—Agreeably to the instructions of the Ontario Government, I have prepared a report on the important subject of the forests of the Province. The object of the Government, as I have understood and endeavoured to carry it out, has been to circulate the information procurable in so popular a form as to ensure its being generally read, and thereby to enlist the understanding and sympathies of all in the valuable work contemplated—that of preserving such portions of forest as are necessary for our future supplies of timber, and for that still more important result, which the maintenance of forests secures the great climatic and agricultural benefit derived from regular supplies of moisture, whether in river, spring, or rainfall.

The subject has long been one of my favourite studies, my first writing thereon in the *Canada Farmer* and other journals dating thirteen years ago, while I have had myself much personal experience, which I have found useful in preparing the report, a work which, I may remark, has occupied me several months.

I have concerning the matter actually presented, followed the plan generally observed in other countries in drawing up such documents, namely, that the first Report should present the scientific aspect of the case as applicable to the country in question, together with statements of what steps have been taken by other governments in such matters, the results which have attended their efforts, as well as the causes which led to their action; accompanied by such additions to the stock of facts as personal knowledge enabled me to supply, and compilations, in as concise a form as possible, of such evidence touching the subject as is on record from the pens of gentlemen well acquainted with Canadian affairs, and such quotations as bear most directly from the most celebrated writers in America and Europe, concerning the advisability of action in the care of and reproduction of forests, and their explanation of the great principles on which such advice is based. Such reports have generally been preparatory to a more exact personal examination of the country, and the obtaining of evidence from individuals in its different localities, which, the writer would suggest, should now be undertaken.

It may be added, that of the various scientific explanations adduced, none has been given except on the highest authority, nor without consulting numerous authorities, of some of which I now append a list. Of those authorities to which I am chiefly indebted, I may mention the various reports presented from time to time to the American Government, the valuable report compiled by the Commissioners of the Ontario Government concerning the Forestry Congresses at Montreal and Cincinnati; the Montreal press reports of the former; the numerous excellent writings of Prof. Hough, U.S. Forestry Department; some very useful and exhaustive reports concerning the examinations made by the East Indian Government in the system of European Forestry (for which I have to thank Hon. M. Joly and Prof. Goldwin Smith); *Le Traitement des Bois*, par Ch.

Broillard ; Les Bois, par Dupont et La Grys ; Les Arbres, par Schacht ; Brown on Forests and Moisture ; and Reboisement in France, by John Crombie Brown, LL.D., Edinburgh ; The Forester, by James Brown, LL.D., Stirling ; Bagneris on Sylviculture ; The Earth as modified by Human Action, by Zeo. P. Marsh ; The Trees of America, by D. J. Browne, New York ; the far-famed meteorological works of Herschel, Flammarion, Glaisher, Humboldt, and others ; the reports of the various conservators of forests in Australia, New Zealand, and India ; Lasett's Timber and Timber Trees ; Chapman's Geology of Canada ; Vallis' Influence of Forests, etc., etc.

It may be remarked that this report, with the same or even less labour, might easily have been made much more bulky. But I have rather chosen to reject as much as possible, so as to leave, in the present form, an amount of information more likely to secure perusal than if further extended.

INTRODUCTION.

As a preface, perhaps I cannot do better than ask the reader to peruse, I need not ask him to admire, the following beautiful piece, from "Nature, or the Poetry of Earth and Sea," by Madame Michelet :—

"Alas, in how many places is the forest, which once lent us its shade, nothing more than a memory. The grave and noble circle, which so befittingly adorned the mountain, is every day contracting. Where you came in the hope of seeking life, you find but the image of death.

"Oh, who will really undertake the defence of the trees, and rescue them from a general and senseless destruction? Who will eloquently set forth their manifold mission, and their active and incessant assistance in the regulation of the laws which rule our globe? Without them, it seems delivered over to the blind destiny which will involve it in gain in chaos! The motive powers and purificators of the atmosphere through the expiration of their foliage; avaricious collectors, to the advantage of future ages, of the solar heat, it is they, too, which arrest the progress of the sea-born clouds, and compel them to refresh the earth; it is they which pacify the storm, and avert its most disastrous consequences. In the low-lying plains, which had no outlet for their waters, the trees, long before the advent of man, drained the soil by their roots, forcing the stagnant waters to descend, and construct at a lower depth their useful reservoirs. And now, on the abrupt declivities they consolidate the crumbling soil, check and break in the torrent, control the melting of the snows, and preserve to the meadows the fertile humidity which in due time will overspread them with a sea of flowers.

"And is not this enough? To watch over the life of the plant and its general harmony, is it not to watch over the safety of humanity? The tree, again, was created for the nurture of man, to assist him in his industries and his arts. But on this immense subject I cannot dwell. Only, it is our very emancipation. It is owing to the tree, to its soul earth-buried for so many centuries, and now restored to light, that we have secured the wings of the steam engine.

"Thank Heaven for the trees! In this book, and with my feeble voice, I claim for them the gratitude of man. Let other writers of greater authority come to their assistance, and restore them to the earth, before she is utterly stripped, before she becomes an arid and uninhabitable desert.

"One day, as seated before a forest of firs already marked for the axe, I was lost in a sad and silent dream. Another dreamer, who could well interpret my thoughts, told me that he came from the Engadine, the most elevated and the coldest region of Switzerland, where the fir ceases to grow, where the larch can barely live, but where the arrolla prospers, and hardily plants its roots on the edges of the glacier. It is a hero! I exclaimed; we are in Switzerland, and should we not see it?' 'You must make all possible haste,' replied the stranger. 'In the war which man has declared against the Tree, the last of the arollas will soon have disappeared.'"

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Map of Forests—opposite page 136.

REPORT

ON THE

Necessity of Preserving and Replanting Forests.

WHEN the paddles of the Frenchmen first broke the clear waters of Toronto Bay, and their canoes grated on the bright beach of sand which then surrounded that harbour, Ontario, from the Detroit to the Ottawa, was under the roof of the forest. It contained at that time, as has been well remarked by one of the best qualified judges in the United States, perhaps the most valuable masses of timber which ever existed in a region of its size. There were hundreds of thousands—nay, there were millions of acres of magnificent maples, two feet—three—four feet through, their rugged trunks rising clear, separate, distinct, to the lofty arches of the forest, like the pillars of some great cathedral, overshadowing and crushing out by their ponderous vitality all inferior growths, so that below a carriage might have been driven for many miles in any direction, unimpeded through the park-like woodland. There were vast sections of beech timber, their clear blue-grey stems standing far away in the indefinite perspective of the forest, and here and there reflecting from their shining surfaces the occasional rays by which the sun was able to penetrate the mass of foliage overhead—great trees—three, or even four, fourteen feet logs to the trunk, a reservoir of plane-wood which would have lasted all the carpenters of the world for a century. There was white-oak, would have ribbed the navies of Europe, and ash sufficient to plank them all to the water-line. There are many perfect works in the forest, there is none more perfect than the white ash. Its shaft, round and perpendicular, sheathed in serrated bark of clear cut channels unique in their beauty, forms a picture the very axe might be loth to destroy. There were hickory trees by millions, the shaggy outer-covering hanging in strips from the huge red-brown trunks, had kept the world in axe-handles till doomsday. There were miles upon miles—there were hundreds of miles of wide-spreading cedar flats, where the traveller's foot might all day long press the mossy covering of their protruding and gigantic roots, while around him still arose on all sides the upright shafts, the curious leaning branches of that most picturesque of trees. There were dark and apparently illimitable forests of hemlock, of which axe and fire have long since found the limit, as the tanners are learning to their cost. There were millions of silver-skinned birches, and iron-woods in countless numbers.

And above all others in use—above all others in money value, everywhere piercing the hard-wood foliage roof, rising to double its height above it ; lofty, dense, sombre, fully exposed to, but almost immovable by, the tempest, stood in far-spreading masses the giants of the forest—the great Canadian pine.

It is not to be supposed that the forest of that day stood in clearly defined sections of different woods. Trees of other species from the predominant always intermixed, but in many sections to so slight an extent that those who saw that vast woodland can well remember where, every here and there, all appeared maple, all beech, or all hemlock, far as eye could discern. "What kind of land is it?" asks Cooper's Major of the Indian. "All sugar-bush ; what you want better?" is the reply.

If the lord of these servants should at any time return from a far country, and demand to know the use the Canadians had made of his talent of timber, we should be puzzled to extricate it from the napkin of fire in which we had wrapped it. For the advance of the Anglo-Saxon across the North American region has been, so far as the trees are concerned, like that of Attila, who boasted that no grass ever grew where his charger's feet had trodden. No destruction was ever more ruthless, more injurious, more lasting in its effects, or more difficult of repair, than that to which Canadians, for the past hundred years, have cheered one another on. Among all the politicians who have in turn saved our country, few of them have thought it worth while to attempt to save the timber. And yet much might very easily, very valuably, have been done towards that end. But the Genius of Preservation was absent, while that of Destruction filled the land with his voice. Here might have been seen a rustic, placidly destroying a grove of white pine, worth a million of dollars, in order to uncover a barren waste of sandy land, which at first gave but little wheat, and has since pastured but a few cows ; there another, devoting to the flames a district of red oak, would have kept Malaga five years in wine puncheons, that he may bare a piece of hard red clay on a mountain slope, which he shall try to cultivate for a few years, and shall abandon when the winter torrents have washed the scanty humus away from the hard pan which all impenetrable lies below. Here is yet another who, to advance himself a little by burning in June a fallow which should have lain till fall, and thereby save a matter of ten of twenty dollars, has let fire run through five hundred acres of good hemlock bush, killing the young trees, girdling the old, and half ruining the soil for future agricultural purposes. Here you might have seen one rolling together and burning great logs of black walnut (a wood invaluable for furniture, of which the Canadian supply is long since exhausted, and the United States supply almost so), in order to make a farm, all the profit of which for forty years would not reach one-tenth of the sum the walnut, if left standing till now, would easily have drawn. Nay, an item which will be more comprehensible by every one, I have myself seen, on the sandy lands near Toronto, great heaps of almost clear pine, worth to-day forty dollars a thousand, given over to the flames.

All old residents of Toronto can well remember the days before the railways—the old wharves piled high with pine for steamboat fuel—the long procession of wood-waggons, two cord on each—down Yonge street, and from the Kingston and Dundas roads. I fancy the pine so used would now sell for a good deal more than all the steamers and all the freight they ever carried.

"We must have the land," said the settlers, "we don't want any boards, and there's no sale for it in town." A hundred miles north of Toronto, and within fourteen of a railroad, I have known heap after heap, acre after acre, square mile after square mile, till the forest was gone, where the splendid and massive rock elms, three to even six feet through at the butt, the long clear basswood, good for many a use, the straight logs of valuable cherry timber, and equally valuable red oak, with beech and maple, hemlock and ironwood, uncounted and uncountable, arose in smoke, a sacrifice to the Goddess of Ignorance throughout the length and breadth of the land.

But one will say, "The land has to be cleared." Yes, and no. It was necessary indeed to obtain land for the plough, but what I shall endeavour to shew in these pages, is that, had great reserves of the inferior lands, and of the mountain lands, been spared the axe, in proper and intermediate positions, good and constant succession of trees, and large supply of timber might have been obtained therefrom, while the land which was cleared would not only have yielded larger crops than the present much broader acreage affords, but would have yielded them at a much smaller cost of anxiety and labour. At this point once demonstrated, we shall probably obtain some valuable ideas as to the manner in which the land should be travelled in utilizing the forests which yet remain to us.

In the settlement of woodlands, such as Ontario was once entirely, it would be well that those entrusted with the duty of choosing the sections to be occupied by new settlers should reserve large portions of inferior land for forest purposes. The settler, in many cases, cleared, much to his own injury, hill, swamp, sand and hard pan which might well have been left untouched, while there was, at no great distance, plenty of excellent land. That poor land, left in forest, would have, by its climatic influence, rendered much more easy, and consequently, much more lucrative, the production of crops on the other and would also, if fairly used, have continued an inexhaustible reserve of timber, of fire wood, and of fence.

Allow me to give an instance of my own experience in this matter, illustrative of the way in which heights of land, which should above all have been kept in forest, have been carelessly deforested in Ontario. On one of my expeditions many years back undertaken in company with some other young men for the purpose of choosing farms among the vast forests then existing in the Province, after travelling a good many miles, we came to a district where there was evidently much good land, none of which, however, seemed at that time to be in the market. It was a broad and a splendid forest, dense with vast elm and heavy oak. There on all sides rose the mighty maple, rich in promise of sap and overflowing trough, intermixed with many a lofty basswood not unsuggestive of futures even sweeter, for amid the blossoms thick among its massing foliage, high overhead in buzzing millions the wild bees toiled and sang. Here and there, perhaps miles apart, a settler had cleared a limited rectangular space, his small log barn and smaller house half hidden by the waving luxuriance of his little patch of Indian corn, his field of wheat, his bit of meadow, where, tall, interweaving with each other, and covered with dull red flowers the clover and timothy, vigorous from the untired soil, climbed high against and even overtopped the four-foot fences. All here was deep and loamy clay. Travelling through continual and overhanging forest, we were not aware of the elevation, but in fact the country through which we were passing was a complete rim of hills, usually arising slowly of

a mountain range. We passed on further, the land did not now appear so rich. It was still strong and fertile clay, but not at all the equal of that we had left. The oaks were smaller, the maples harder of trunk, and dying at the top, dark masses of hemlock frowned perpetual from the glade, and every here and there the spectre-like balsam, high, gaunt and spire-crowned, pointed his warning branches to the hard, red soil below. However, persuaded by settlers, who at any risk wished to bring other settlers around them, we bought land, cleared it and built on it. Other settlers came and did likewise. Then a while afterwards, when our road and clearings had introduced daylight for many a mile, we understood what we had done—we had occupied the height of land. The rich slope we had passed on one side was equalled, had we gone that far, by a slope of equal richness on the other side of the mountain. But we had halted, and many had halted, on the watershed, the summit of the mountains, a great table-land of many thousand acres, rich in its uncleared state with springs of water (on my hundred acres I had six or eight which promised to be never-failing), but of far inferior land to that which lay below. There was the great mistake. The authorities of that day knew nothing of it, the settlers knew nothing of it; and those great slopes, extending many a league, are now cleared of trees from highest ridge to far-distant valley on hither and farther slope, or showing every prospect of becoming so. The inevitable consequences will as surely follow. The land, even before I left that part of the country, was washing rapidly from the top. I have seen it gather eighteen inches deep against the fence on the lower side of a field. As for floods, since the leafy guardians of the height have been dislodged, I have seen a creek which would have flowed in full volume between one's joined hands, with two hours' rain roll down a red torrent which bore a ten pound stone some distance on its surface before it sank. The old forest, left above, would have held the rain in bed, leaf, and tangled brushwood for days, and sent it forth in gentle and gradual streams to the slope below. The summit land should never have been sold for settlement. With proper care in thinning and reproduction of trees, fenced against cattle and managed by foresters, that wide extent of tree-crowded height might have stood for ever a valuable forest, furnishing yearly lucrative supplies of saleable timber, and a far greater benefit, giving a continual fertility—by attracting rain, by preserving its former steady and numerous water-courses (seven-eighths of which are now dried up), and by preventing the now perpetual washing away of the soil—to all the far greater extent of far more easily cultivable land below. Let any one who knows the district I speak of think how scarce barn timber and even firewood now is there, and consider how valuable a large reserve on the height would have been to the whole country. This opportunity exists no more. The land is in private hands or it is cleared. But we have many mountain ranges still unsold which might be better managed.

Perhaps I may be permitted to refer again to my remembrances, and to remark that, a life-long resident of Ontario, and in my day largely engaged in clearing the forest, besides having had continual occasion to observe the work done in the same line by many of my relatives, who, coming to this country in the earlier part of the century, were mostly farmers, and what was long synonymous, choppers, I necessarily know something of the process and results of clearing. Their axes rung in many an Ontario forest—in the dense bush ^{grader} ^{carried} among the heavy beech of the old Trafalgar survey, on the treignt way

the pines of the Yonge street line, away north in the Gwyllimburies, farther yet to the right and left of the Georgian Bay, in the woods where now stands Whitby town, and in many another forest glade, now forest glade no more. I have seen vast districts around me, where from elevated points we could once overlook many thousand square miles of forest and of lake, changed in a few years from leafy shades to sunny fields. In all my experience, though I have known many farmers who, believing that "ther'll allus be wood," cleared off every stick, and have now for many years bought wood, and in some cases coal; and though I knew some (myself included) who made spasmodic and ignorant attempts to preserve some forest, yet I never knew one who seemed at all likely to secure to his successors enough timber on their own land. No doubt there are such; but I have not been aware of them.

This arose from many causes. Some cared little so their turn was served, and I have seen a farmer point to his ten or twenty acres of wood yet uncleared, with the remark, "Well, I guess that'll last my time. I didn't own no bush to begin with, nor no land neither, and my sons'll be better off than I was, for they'll have the land anyhow. Besides, there'll always be lots of wood in this here wooden country." Then, the pressure of poverty was sometimes severe, and men sometimes driven almost to starvation point, had little scruple in destroying a hundred dollars' worth of timber to procure five dollars' worth of wheat, when they knew they could get the five dollars, could not get the hundred then, and were by no means sure that they ever would. Again, ignorance was very general. Few of us knew that, in destroying the forests, we were, in effect, pledging ourselves to pay a heavy rent for our farms. There is nothing now better known to the world of science, than the fact that any deforested country will cost the cultivator at least four or five dollars more per acre, to obtain the same crops which nature would have assisted him to procure, had a proper interspersion of forest reserves remained to continue the natural moisture and preserve the original fertility of the soil. And I may remark that it was impossible that this should be then known, as it is known in the present day. The knowledge, or rather the proof of the knowledge, had not been arrived at. It is only of late years that even the older nations of Europe have attempted carefully to investigate the matter. For instance, when, in 1870, I took occasion to write in the "Canada Farmer," and other journalistic literature of the day pretty extensively concerning this matter, I found no such stores of knowledge, or of reference, as at present exist.

Even in that short interval of twelve years great progress has been made. Fresh experiments have been carried out, and new and valuable information obtained, in American, European and Asiatic countries. The American Government, warned by the rapid decrease of their forests, and consequent and evident injury to the productive power of their soil, have for some years past had in operation a Forestry Bureau, which, under the efficient management of Dr. Hough, is doing excellent service, and has now issued its third volume of reports. France and Switzerland, convinced by recent experience of the injurious results of deforesting their mountain districts, are replanting at great expense the most elevated plateaux. In the case of the former country, vast additional outlay has been incurred, and with the most gratifying success, in establishing along the sea coast great plantations of valuable timber, a benefit to the climate, a source of profit to the proprietors, and a complete remedy for, and prevention

against the wind-carried waves of sea sand, which previously every adverse gale scattered in masses far inland, to the utter destruction of the arable soil. In both these countries, within the same period, as well as in Germany, in the far distant region of Australia, and, indeed, in most civilized lands, schools of forestry have been improved or have been established, provision made for the drawing thence annually a body of trained foresters for the service of the State, and governmental machinery created, whereby their services will be at once and continually available for the preservation of existing and the planting of fresh sections of woodland.

But of all this, while the chief mass of Ontario timber was destroyed, little was known to the world, and less to the destroyers. If, here and there some one had more skill in natural philosophy than his brethren of the log heap, he also had skill to see that he alone could not impress the masses in such a matter, and that his efforts would do but little to preserve the naturally assisting relation between forest leaf and ear of grain. Some few I heard of as having enclosed, thinned and protected from fire and cattle their modicum of woodland; but so few and far between were these that I never knew personally one. I knew thousands who did not. Those few who had means and will lacked experience and teachers.

I remember, when little over twenty years of age, I made my first experiment in clearing a hundred acres. I left ten acres of solid, lofty timber in a strip along the north side as a shelter against the coldest wind. It was for ultimate, not for immediate service, for behind it stretched, broad and untouched, the forest of many miles in depth. The strip, when its border stood fully exposed by my clearing operations, formed a pretty picture. Thick with dense young trees below, and great hemlocks, red oaks of mighty size, waving beech and heavy maple nodding their leafy heads, above, it stood (for my fires had not touched it), from ground to summit twigs, a wall of living green; which, when the cool daybreak air of June, purified beyond the imagination of city dwellers by many a charcoal heap, had covered the great leaf masses, the branches, the angular rail fence below, and every forest weed around, with myriads of bright and glancing drops of dew, shone, flashed and waved along its whole emerald length, and down a thousand opening and closing vistas, like the wall of Fairy-land itself. "These other country fellows," thought I, "chop down everything, but I shall preserve this beautiful growth, at least, whatever happens."

Well, time passed on. Next year was a dry summer, and an English gentleman who knew considerably less than the little we knew, cleared at one fell swoop a hundred acres behind mine, and burnt the soil of half his farm beyond redemption in the process. I was many miles away, and what shall hinder his fires from, by way of a gentle commencement, running all around the border, and some forty feet into my pretty reserve. Down went my young maples by the thousand; my little hemlocks, their roots burnt from under them, stood in blackened and spectre-like rows. The beauty of the strip was gone. Next year, a poor settler lived near with some cattle he could not feed, so turned them loose. They did not leave a young tree nor a green branch they could reach in my ten acres. The result of these combined attacks was that the moisture seemed to leave the strip. The vegetable coating of massing roots and rotting leaves was swept away, and the great trees which

fire and cattle could not destroy, seemed to dry, perish and fall of pure desiccation. In five years the green bit of fresh forest was a desolation of dry and rattling stalks, fit for nothing but the axe, and scarcely for that. But (and here was our lack of knowledge) had fire and cattle been excluded, the green bush had, with care, been green to-day.

Throughout Ontario clearing has been largely similar. It has been pursued without plan or system, utterly oblivious of the great and vital principle that, in this country, as in all others, there were certain portions which should be left as forest, because the ground would be valuable for that purpose, and scarcely for any other; and certain portions which should also be so left, as elevated above the rest, they form the natural conductors to attract rain, store-houses to preserve it, and slopes down which, in driest weather, the refreshing streams still carry the reserved moisture from the wooded hill top, to the arid and parching soil at a distance, but below. Then, as for reserves on each farm of timber and fire-wood; let us consider how these have been provided for:—

On each one, two, or three hundred acre lot as it happened, the original proprietor left generally "some bush," here, there, or anywhere in that part where it would least interfere with the cultivation of his cleared land.

Well, fire would run in some of these reserved portions and it would blow down, fill with weeds, become an eyesore and be cleared off and "cropped."

Or, the farm would be divided and sold; the bush lot buyer would have too much bush, and would clear most of it, so that now the two or three hundred acres would have but ten or twenty acres of forest.

Or, the whole would be cleared; the cultivators saying to one another, "Oh, there's lots of bush down on the sandy flats that never will be cleared (and here comes in the saving clause) in our time; we can always get wood hauled to our own doors in winter at one or one and a half dollars a cord. Let us clear off all the plaguy trees and crop the land!"

Or, a demand for cordwood for railroad or other purposes would spring up, and the farmer would be induced to sell his bush to the choppers. Notice how this would affect the one who had cleared. He had said, "So-and-so has hundreds of acres of wood; he can always sell to me." Others say so of others; but the demand carries off the very woods they had been depending on. Then they must cut down the small groves they had been intending to keep "no matter what happens;" or they go to others and say, "Well, wood's very scarce round here; I don't want a twenty miles' hauling job; tell you what, if you'll let me have some out of your ten acre block, I'll give you a dollar and a half a cord and cut for myself. There!" The offer seems large to one who has been used to pay for having the wood destroyed, and he takes it. Others offer more, and the ten acre lot goes, and is in grass.

Then the masses of woods, bounding his vision on every side, here a solid wall bordering his farm, there a strip along the horizon, were at first apt to deceive the settler into a belief of the continuance of the forest. I mentioned one a few lines back as saying, "There will always be wood on the sandy flats." I will give here a little bit of experience showing how such expectations have been dissipated.

Along the low shores of a great lake stretched a forest, wherein stood cedar trees, good enough and many enough for Solomon's Temple, if he had been contented with

white instead of red, intermixed with many a solid acre of the largest and tallest beech, maple and basswood I have ever seen. We used to look from our more elevated region upon this great carpet of tree-tops covering the valley with intermingling foliage, and many of us thought we need keep no timber, we could always buy it or own it there. Well, I was a boy, and must needs go raspberry picking one dry summer day, when we had had no rain for six weeks, and we must, of course boil our tea-kettle, or rather big tin can, and apparently the fire went out; and I am afraid in fact, we cared very little whether it did or not, for it was either long before the days, or far beyond the scope of the three months fire regulations, though they now are in full force in that district. Well, we went home, and about a week after, a column of dense black smoke could have been observed to the northward, and somebody said, "There's a big fire along the shore." There was indeed. The column of smoke broadened and blackened, and extended for weeks, nor did it subside until the heavy September rain, nor was utterly quenched before the winter snow. The devastation was melancholy to behold. The forest had fallen before it like grass before the scythe. Our tea-kettle had cost thousands of acres. Cedar and beech, oak and maple, were no more, and in their place, many summers after, a vast white carpet of close standing Canada thistles used to overspread the land. No more reserve of timber for us along the lake. But some will say, "At all events, the loss of the forest gave room for crops." Unfortunately, it could not. Nature had planted and cultivated there the only crop such soil could grow.

The trees, by protection and careful use, could have been continued a source of income for infinity; but its burning took the top soil of a few inches of black earth from off a carpet of pebble stones and boulders. The best of the soil was gone, and nothing less than three centuries of rest, or the income of a Rothschild could restore it.

The settler, too, can never fully realize the vast power of the settlers who are coming. He sees indeed, the sixty or a hundred acres on which he has abolished the forest; but still he sees everywhere the embowering shade; he drives to the village through avenues of trees; he visits the next farmer across five miles of dense wood; nearly every hundred acres he sees is a hundred acres of timber, but he does not so well understand, at first, that for each there is an owner, and that each piece of good and many of poor land will as surely, in a few years, find some one prepared to clear it, as that each separate snowflake in a January field will before June meet a sunbeam to disperse it into air.

If we look from end to end throughout the settled portion of Ontario, we shall find what the foregoing observations have led us to expect. There are as yet, on many farms, portions of forest remaining, generally of small extent. But, as a rule, little care is taken to exclude cattle or to continue in its efficacy the timber plantation as a perpetual source whence many sturdy trees can every year be taken without injury to the continuance of the grove. On the contrary, all over our older districts, as any one who has travelled them as I have for the last forty years is well aware, the patches of reserved timber are every year becoming smaller and smaller, nor is there any replantation observable, at all calculated to fill their place.

It must be thoroughly understood that unless powerful efforts be made in the direction of replanting, the cultivated portions of Ontario will become almost denuded of trees. The whole force of circumstances and nature point inflexibly in that direction. Portions

of the forest left standing will not, without care, continue many years in a state productive of timber or beneficial to the climate.

These trees have grown, root and trunk, in the shade. The outside rows, exposed to the sun, wither gradually, decay, and are easily uprooted by the force of the wind, injuring the inner and younger trees in their fall. Then, if cattle are allowed entrance they will kill every young tree, a process which, as far as my observation extends, dries up the soil in small blocks of forest, and precipitates windfalls of large trees in all directions. In fine, the forest in most sections of Ontario, if left to itself in isolated patches, rapidly deteriorates. When we add to this the continual pressure in all directions, inducing owners to sell their wood and clear their lands, we must admit that if no active movement be made for their preservation, the forests which once overspread Ontario will soon give place to a bare and denuded surface, broken only by the low branches of an occasional orchard or the few trees which some one, here and there, has set in line along his fences or around his house.

That there is cause for much apprehension in the matter is a fact which can be well proven by contemporary experience, and it would be impossible to find a better method of obtaining such than by examining what has happened in those portions of Canada settled previously to our own. Let us look to old Lower Canada, the present Province of Quebec. Let us first consider the character of its inhabitants. The Lower Canadians are industrious, thrifty and home-loving. Their climate is a severe one. So far as the habits of their ancestors may be thought to influence, it may be remarked that no other nation were so careful in the preservation of their forests as, when they settled Quebec, were the French. There is, then, every reason to suppose that Quebec has been as well treated in that respect as Ontario is likely to be. May I, then, ask the attention of my readers to the condition of the older settled portions of Quebec, a state of affairs which any one travelling in that Province can verify, and which no one aware of the character of the witness whose testimony I am about to quote, will for a moment doubt. I allude to the Hon. H. G. Joly, of Quebec, from whose valuable report on "Forestry in Canada" I shall elsewhere quote further. With reference to the matter at present before us he says:—

"As far back as the year 1696 the attention of the French Governors of Canada was drawn to the wasteful destruction of the forests, and they were called upon to check it. Nothing, however, was done by them, and little has been done since. The result stares us reproachfully in the face, especially in the Province of Quebec, the oldest in the Dominion. The old settlements are painfully bare of trees; you can sometimes go miles without seeing any trees worth looking at, and the passing stranger fancies himself in a country more denuded of trees than the oldest parts of Europe. There is a large district of very good agricultural land south of Montreal, where the scarcity of firewood, which is a matter of life and death in our climate, has compelled many a farmer to sacrifice a fine farm and leave the country. There are many other spots in the Province nearly as bad, and unfortunately the process of destruction is going on even now in more places than one."

There is no reason to suppose that the residents in our Province of Ontario will be, if left to their individual guidance, more careful of their wooden reserves than have been our French Canadian friends. If on the one hand the Lower Canadian habit of partitioning their farm lands among the members of a family was likely to create a demand

for more fuel and more timber from each hundred acres than is our own, it is to be remembered that in their rigorous climate they had greater cause to fear a scarcity, and had every necessity to practise the art of replanting and of husbanding their woodlands. Nor had they at the time most of their clearing was performed an excuse for carelessness in reservation of timber, which has to a great extent prevailed in Ontario, namely,—the certainty of being able, by means of the number of railways, which in every direction chequer the surface of the latter Province, to purchase coal at reasonable rates. The Province of Quebec had been sixty years in the hands of the British before coal was even to any extent used in New York city. On the other hand, to my own knowledge, many an Ontario farmer has cut down his last tree, sold off the timber from his last five or ten acres of bush, with the consoling reflection, “Well, if the wood does run out, I can get coal, and folks say it’s hotter and cheaper.” Taking all this into consideration, no reasonable observer can doubt that the settled portion of Ontario is on the high road to becoming as destitute of woodland as Mr. Joly’s pamphlet pictures any part of Quebec.

And here I will ask my readers to consider a point which might, perhaps, better come later, as more connected with what will then be introduced, but which may be now mentioned as concerning the Province just spoken of. We will remark, before we lose sight of this very important feature, the injurious effect this over-clearing has had on the Province of Quebec.

It is well known to every person of ordinary information that in times past quantities of wheat were raised in and sold by the Province of Quebec. Certain valleys drained by great rivers there, covering vast areas of land, were thought to be the very home of the wheat plant. Before 1830, the yield of wheat in Lower Canada is said to have been enormous; between then and 1865 it sank to an insignificant fraction; since then better farming has to a certain degree restored it, though to nothing approaching its old fertility. It has been usual to call the process which caused the injury “over-cropping.” No one doubts that with good farming and favourable seasons the land might, as much land has, have stood the cropping without deterioration. But if it could be proved that, on the contrary, the process of clearing the forests tended to carry away the fertile portion of the soil, and had done more, had even prevented the possibility of seasons continuing as favourable as formerly, would it not do much to account for the falling off? What if we can discover by undoubted testimony that this is so? We shall, I think, in the course of this book find proof of these two important points.

First.—That gentle, frequent and refreshing showers, where a country is to a proper extent retained in forest, are likely constantly to occur throughout the summer months, giving their well-known and powerful stimulus to all the growths of the field.

Second.—That when such proportions of forests are not retained the showers are not equally distributed; they do not descend at the especial time, nor in the manner beneficial to the plant, and being precipitated in floods, the result is:—

That they do not frequently, and therefore not nearly so advantageously give moisture to the earth. That, coming in floods, they bear away, in discoloured overflow, much of the richest earth of the fields. That extended areas of pasture, meadow and plough land thus rendered comparatively infertile, cannot yield the means of keeping

much cattle or obtaining much manure, and the land thus again, from this secondary cause, yet further deteriorates.

If we take into consideration what has occurred as previously stated, concerning the destruction of forests in the Province of Quebec and its results, and remember that the same state of affairs exists in many of the older settled States of the adjoining Union, and remember also how little isolated and individual action can do in the way of remedy, there is no avoiding the conclusion that, in our own Province of Ontario, unless the strong hand of Governmental assistance is brought into operation, even the small reserves of woodland which here and there dot the surface of our present cultivated territory will disappear, and their absence will produce the same results as have in other countries invariably been found to follow similar losses. In the eastern portion of the United States the same deterioration of soil is observable, and has proceeded step by step with their disforestation. Many once fertile farms there are now abandoned through sterility; while, as if to point out more clearly cause and effect, as will be shown by quotations further on, the operations of replanting which have been in progress for thirty or forty years in certain districts there, have not only produced new forests but improved growth in the adjacent cultivated lands. This is especially the case in Massachusetts.

Speaking of Massachusetts tree planting, we may remark that that whole eastern coast, following the French success, is conquering the sand drift with the pine tree. Numerous instances are given where these artificial plantations are now yielding merchantable timber, and some where the original woodlands, preserved for that purpose and properly managed, had yielded larger returns than money devoted to the purchase of lots afterwards forming part of the most flourishing cities, and of course paying well. It should be noticed here that Nature, always benevolent, has offered a remarkable inducement here. The very lands most useless to the agriculturist—the light and almost barren sands—are those on which, according to French, German and American experience, we may hope for most success in planting the most desirable, the most rapidly disappearing of all our timber, the great Canadian pine. Sombre, indeed, as that dark tree passed by Æneas on the downward way.

“*Ulmus opaca, ingens, quam sedem Somnia vulgo.
Vana tenere ferunt, foliisque sub omnibus hærent;*”

or, we may translate freely,—

Vast elm, impervious to daylight's beams,
Where live the Visions and where haunt the Dreams.

But no tree of all the forest will serve Ontario so well as these tall, gloomy guardians of the soil, valuable for the timber they yield, doubly valuable for the climatic influence their giant height and dense foliage exert, forming a link as they do in the transmission of moisture between the heavens above, the earth beneath, and the waters under the earth.

Already a great number of the smaller streams which formerly flowed continuously throughout the length and breadth of Ontario are dried up, or only run during the floods produced by spring thaws or autumn rains. With the utter disappearance of our forest reserves, those which yet remain will more and more entirely disappear.

Formerly the interspersing belts and large masses of yet untouched forests held, in a manner afterwards to be explained, during the summer period of vegetation, great reservoirs of moisture, which causing a continual flow of water-courses throughout and under our fields, watered and fertilized the land, and was in itself, as we shall hereafter see, at once the cause and the result of the frequent spring and summer showers which so greatly aided the labours of the husbandmen.

It is noticeable, I may remark at this point, that in many parts of Ontario where formerly portions of newly cleared forest ground could be reasonably expected to yield a large crop per acre, adjoining land as well wooded and of precisely the same constituents, so far as soil is concerned, will not now when cleared and cropped give anything like the same amount. It is also observed that ploughed land some years under cultivation, in similar localities, compared with ploughed land of many years back, although now worked with the advantage of improved implements, far greater care in the rotation of crops, and the application of a quantity of manure quite unobtainable in the old days, frequently fails to yield an equal return to that formerly secured with rougher cultivation and infinitely less labour.

The old settler remembers the once spontaneous growth, and is apt to say with Hood in the "Haunted House":—

"A merry place it was, in days of yore;
But something ails it now; the place is curst."

The land is haunted by the spectre of its former fertility; the fertility which in our greed we slew. We were not satisfied with the golden egg of the field, we must, to get all at once, kill the goose—the woodland which nurtured the field; and we have neither fair forest nor fat meadow. We said with the fabled rebellious members, "What is the good of feeding this useless stomach? The limbs are the valuable parts." "What," said we, "is the value of this woodland? The field it is which gives the crop." But as the stomach got thin the limbs got thinner; as the forest grew small the field returns grew smaller. We had destroyed the regularity of the summer rain, that for which Virgil bids his husbandmen pray:—

"Humidæ solstitia atque hiemes orate serenas,
Agricolæ,"—

or, if you accept my translation of the first part:—

"That moist and warm arrive the spring,
That frequent showers the summer bring;
Still, farmers, ask when vespers ring
Ask in your matin prayer."

As I have just remarked in the case of Lower Canada, we have been too apt to believe that over-cropping alone has occasioned the evil. It has no doubt had something to do with the matter, but there is too much reason to believe that an equally powerful factor is to be found in the far less favourable distribution of moisture which our careless disforestation operations have brought about; and if this be the case even at present, what have we to look forward to as our present scanty interspersing reserves disappear, except a still more unfavourable climatic condition and one becoming worse much more rapidly

than in the commencing years of its progress, as the stone rolling down hill at first slowly, flies faster and faster as it continues to move. Much of our valuable soil has already been washed away from the uplands; many pastures formerly moist and green the summer through, now dry and bare, furnish but scanty picking in most years to one or two cows and a few sheep, and a very large proportion of our arable land, plough it and manure it as we will (as just observed) smiles not with the promise of former days, when, as the proverb says, "If you tickled it with a hoe, it laughed into a harvest."

The prospect is that if no governmental actions be taken (and I am now speaking of our counties which have been long settled) as soon as the disforestation process is as complete as it threatens to be, much of our higher plateaux, together with the long and sometimes steep slopes which, facing towards their nearest river beds, form so large a portion of our best land, will lose fertility in the course of a few years to a marked extent. For the rain will fall, the snow will descend, and will lie; but where disforestation is general, instead of being deposited—the first in refreshing and growth-producing showers, the latter, by its slow melting in the woods feeding our thousand springs and rivulets, passing in all directions under and through the cultivated fields, and yielding to them that moisture which is to plants what the blood is to the human frame—will come the rain in heavy torrents, which, instead of soaking into and manuring the cultivated land, will rush violently across it, melting the snow in violent floods during thaws, and both carrying away millions of cubic yards in solution of the cultivated earth that, had forests been left in proper extent, would have remained, and not only would have remained, but would have been enriched by the slow and beneficial passage across and through it, of those very waters which now remove it from our fields. Nor do the lower grounds escape, for none are so low as the bed of the rivers which drain them, though the fall may be less steep thereto.

The reckless disforestation, so strongly condemned by many American writers, which has been practised by their countrymen, is now bearing its fruits in the terrible spring and autumn floods which of late years have affected large portions of the United States. The Americans might spare much of their care for the channels of the Mississippi if they would restore the groves cut from the hills which fed its sources. To disforest a mountain slope is to devote the height to barrenness, the valley to flood, and both to parching drought when drought is most injurious, when

"Exustus ager morientibus æstuat herbis."

Added to this absolute abstraction and loss of soil—and to a much greater extent richness of soil—the loss by cropping, so to speak, in spite of nature, of taking from the soil without allowing the recuperating influence which Providence has placed in position to assist the farmers to perform their work, there is but too much reason to believe that we shall in Ontario, unless care be taken, find ourselves in the position in which too many countries now find themselves—compelled in order to grow crops and feed cattle, to give double the labour, and yet not receive the return we might for half the work, had we allowed the assistant forces of nature to remain in sway, and not destroyed the woodlands through whose agency they benefited the region wherein we dwell. To those who have not considered the matter, these statements may seem overstrained. If my readers

follow me I will endeavour to show them how well they are based on facts, and how deep our need in Ontario of action before the evil increases to a much greater extent, and while the means of prevention are within our reach.

I have spoken of the cultivated region of Ontario, which has been formed from our best lands—our deep clay loam, and rich limestone country. But close to us is a far greater danger in our inferior lands.

The province of Ontario is not a broad limestone bed. When we go north a couple of hundred miles, say as far as Muskoka, or a line running from it south-east to near Kingston, we came to a region of far less fertility, because based on a rock far less favourable to decomposition into fertile soil—here all is based on granite. There is no limestone, there is no lime. You will find yourself as you go through Huntsville, Bracebridge, Magnetawan, and all the great Nipissing region, considering how cold the country, rather startled to see that very few of the houses are plastered inside, but all wainscoted with thin pine. You will find many large hotels without an atom more lime about them than just built their chimneys; and that drawn a great distance at much cost. There is no lime, it is a granite land. Be respectful, for you stand near the very framework of the world, the great Laurentian rock. For my part, I had as soon my earthly station were somewhere else. The land is not that of the old Home District. The rich clay of the other is not here; it cannot be; there was no lime to make it,

"Ere yet the little rills began
To feed thy bones with lime, and ran
Their course till thou wert also man."

There is clay; but it is whitish, soapy, sandy; and there is a vast preponderance of soft, peaty, powdery soil. There is much good humus in this, if it could be preserved until a thick clover bed overlies it (and it will grow excellent clover), but it is, above any land I have seen, that in which, when dried and thinned by partial settlement, I should fear the ravages of fires. I have passed over many of what are called balsam flats, which cover a vast part of that land, and though I heard some were richer, yet it was always my luck to be able to dig the tomahawk in the earth a foot deeper than its fifteen inch handle, and find nothing but grey powdery soil resting on powdery soil, and that on red sand or poor white clay. There is much birch timber, but largely dying at the top—the sign of weak soil. There are, left by the lumbermen, many poor or young pines; there are good beech and maple, but not the beech and maple of the old Ontario woods. There is, where the lumberman has not wrought, much fair pine; but this taken away, it will not be a heavily timbered forest, and it is one which will dry, especially as soon as the settler cuts gaps in it here and there, and thousands of cattle are let loose to do more damage than hide and horn, beef and tallow will ever pay for or begin to pay for. I say what a life's hard won experience has taught me,—that they will dry the land, that fire will run there, and that it is the very soil, and that it is the very timber where fire will do much damage. On the high ridge lands it will burn to the bone. Let anyone go a few miles north of Rosseau (many of our tourists yearly do so) and look at the forests they will see there, or what were forests where the fire has passed, and the bare white rock is visible as far as eye can see, with the ghosts of trees standing, gaunt, black, and charred, in long and hideous rows. Yet this was forest protective of springs and

moisture, creative of rivers and streams. It might have been kept in forest, but replanting is scarce possible in many places there.

“ All the king's horses and all the king's men
 Couldn't put Humpty together again.”

However, in the softer soils, fire will not reach the rock, but it will surely run fast and far, and burn deeply and most injuriously into the life of the land (the vegetable humus on which in such a soil, the only hope of the agriculturist lies). And yet here is the region, the very region which, above all, we should endeavour to keep wooded, green, and flourishing.

Here we are near the height of land, the great water-shed which crosses the east of Ontario, on this side of which our streams flow into the lakes, while on the other they run into the Ottawa River. This height of land stretches from north-west to north-east, from near Nipissing till it strikes the St. Lawrence near Kingston. If you look at the surveyor's details of townships surveyed, you will find all this to be described much as land is pictured in the Nipissing and Muskoka districts. It is at present emphatically a land of moisture and of streams. There are numerous and beautiful lakes, there are rivers and water-powers right and left which would delight the heart of a manufacturer; there is the water, the very water he wants to aid the production of woollen and cotton goods—the water free of lime. The housewife may there boil her tea-kettle for years, no rock will form inside.

The great slope leading to this watershed, and stretching to and past the Ottawa, bordering the north-east of the settled portion of Ontario, is, so far as fire has yet spared them, clothed with woods. Partly the lumberman has here and there taken out timber, partly they are untouched by his axe-blade. While in forest they are for all Ontario east of Toronto our reservoir of moisture, our mother of waters, our feeder of streams, the streams which flow from this water-shed across our Province. But civilization is reaching them in its most destructive mood, and all along the southern border of this mass of forest the sturdy agriculturist frets its edge with fire and steel. He pierces it with roads, he clears his isolated farms deep within its solitude, the forest falls before his axe, it dries and shrivels beneath the hoofs of his cattle; and still, as clearing operations penetrate farther and farther from its outward trees, this great forest becomes drier and yet more dry. It is not a rich and deep-rooted forest such as existed in former days near

“ Wild Ontario's boundless lake.”

It is a forest, the outer edge of which, dried by clearing operations, may be relied upon to burn in dry summers, and not unlikely to burn terribly and devastatingly, and for many miles. My readers may remember the fires three years ago, in the Muskoka district, where it may be said, we had just commenced to attack the corner of the great wood clothed watershed slope of which I speak. If they had travelled, as I happened to, forty miles by stage through that district then, the clouds of smoke obscuring all around us, the glare of the fires visible right and left in many directions along the darkened horizon, the snapping and crackling of the giant trunks continually sounding in our ears, and occasionally passing near some great roadside tree, clothed in a mass of fire, threatening to precipitate itself in destruction on coach, horses and passengers below, they would

have some slight, though even then, but an outside and superficial idea of what a forest fire means.

If fire should obtain any serious headway there, Ontario with *Æneas* may well say,

“——— *Jam proximus ardet*
Ucalegon.”

It is frequently said, “Ontario has plenty of forests; there is yet fifty per cent. remaining; let us attend to more important affairs.” Most of the fifty per cent. remaining might, so far as it is likely to benefit the older portions of Ontario, as well be in Greenland. Much of it is in Algoma—much more far in the Parry Sound or the North-West territory, where it will have little climatic influence here. Or, it is said, “Some day; there is yet no need.” Now, in August is wheat harvest; what would we think of one who said, “Oh, we don’t need wheat till August; we shall look after it then, and sow some!” But all agree that we shall some time need to grow forest in Ontario. If so, now is late enough to plant, for before we reap *that* crop, with some trees twenty, some forty, some seventy years must pass. And it is agreed that some time we shall regret more forest was not preserved. If so, it is none too early to see about it, for in a few years all worth preserving will be far beyond the reach of such an effort. Are we to sit down to make our musket when the enemy is charging up the slope?

In a word, the great forest to the north and north-east of Ontario, our principal forest reserve, as the one which feeds the sources of most of our streams east of Toronto, is likely under present conditions to disappear much more rapidly than did the more heavy and more deciduous woods in our older land. Thus, it appears to me, as one who has had considerable experience in clearing land, and much opportunity to observe the effects, and who has since given much study to the question of loss by over disforestation, and possibility of replantation, that the whole of Ontario is in great danger of heavy loss, unless action be in time taken by some authoritative and powerful hand. There is yet time to take this action, and the following pages are intended to present in order:—

1. The scientific aspect of the case.
2. Corroborative evidence from other lands.
3. Measures being taken elsewhere in pursuance of the same object.
4. Some suggestions as to the action necessary.

THE MECHANISM OF A TREE.

A tree (and I will beg my readers to follow this attempt at explanation closely—all depends on it) receives its nourishment from the roots. These correspond to the mouth in the human frame. Now, as in the human frame the nourishment received is, after being supplied to the blood, exposed to the operation of air in the lungs before it is fit to give fresh material to the body, so in a tree, the nourishment taken in at these tree-mouths, the roots, passes to the lungs of the tree, and there, by contact with the air, is rendered fit to supply fresh material to the tree. These tree lungs are the leaves.

This operation is effected by the passage upward, from the soil around the roots, through the trunk, the branches, and every twig of the tree, to the leaves, of a large

quantity of water, containing in solution the nutriment for the tree. Arrived at the leaves, a process takes place which separates, by means of contact with the air, most of the water the roots had taken in, from the valuable nutriment, and throws off, in vapour, the surplus water into the air. At this same time certain constituent portions of the air are utilized and mingled with the nourishment retained. This all, now a small portion in comparison with what had arisen from the roots, yet retaining enough water to serve as its vehicle back, is returned towards the roots, depositing in its way, in leaf, bark and root, what is needed there for the growth of the tree. In these they undergo, especially in the bark, further fitting and digesting processes, before they assimilate with the substance of the tree. The water which was retained to carry them down, being now needed no longer, passes out at the roots.

If the reader choose to peruse the three following paragraphs, he will find from the pen of the learned Mr. Brown, a more scientific and exact description of this process :—

“The water thus absorbed by the several cells composing the spongioles of the root is by a similar process absorbed from them by cells behind them ; and by continuous repetition of it by those beyond the moisture absorbed from the soil is passed on and on, from the extremities of the rootlet to the extremities of the smallest twigs, and to the furthest and the loftiest extremities of the branches of the trunk. There, through the leaves, a part, and that a large portion of it, is given off into the atmosphere, while a part, comparatively a small portion, is returned by the same duplex process of exosmose and endosmose by the same cells, and others, their progeny, towards the root. By the way is deposited, by exosmose, nutriment for the tree, the leaf, the flower and the fruit ; and the residuum is in part deposited by the same process in the leaves, the bark, or the root, and passed off into the soil by the exosmotic action of the cells composing the spongioles of the root.”

“In the back of the leaf are numerous stomates, or mouths. The structure of these differs in different plants, but what may be considered the typical structure is two elongated cells, resembling a microscopic black pudding or thick sausage, so built into the structure of the skin of the leaf, that this will not admit of their being further elongated ; each of these is, along one side, attached to that skin, but on the sides along which they are in contact they are free. When moisture is in excess, they become distended, but the structure of the skin of the leaves is such that they cannot be elongated, and they bulge away from each other, leaving a wide opening between them through which the vapour with which the air surrounding the cells in the interior of the leaf is charged, finds an open exit. When the pressure is relieved, they, having lost some of the moisture or water with which they were filled and distended, collapse to such an extent as to diminish the opening ; and in this way, exactly to the degree required, they vary and regulate that aperture—varying it, it may be, I shall not say twenty times in the day, but, if necessary, twenty times in the minute ; and if drought become such as to render it desirable that every drop of moisture in the plant should be preserved, under the influence of that drought they become flaccid and completely close the aperture.”

“Of the extent of the provision made for this evaporation some idea may be formed from a consideration of the number of the *stomata* or stomates to be found in the leaves of plants, often symmetrically disposed. The number varies in different plants, for

which variation a reason may be found in the different conditions of growth to which they are subjected in their several natural habitats. In the back of the leaf of the apple tree, there are about twenty-four thousand stomates to the square inch. In the leaf of the lilac there are a hundred and sixty thousand of them to the square inch. Sixty thousand have been reckoned in a square inch of the under surface of the white lily and three thousand in a square inch of the upper surface. In the leaves of the cherry-laurel there are none on the upper surface of the leaf, but ninety thousand have been counted on the lower surface of the leaf. In the true lilies they are so large that they may be seen with the aid of a simple lens of an inch focus. In the water lilies and other plants having leaves which float upon water, all the stomates are on the upper surface, where alone evaporation can take place. Leaves of plants which grow entirely under water, where there can be no evaporation, have none."

The quantity of water drawn up from the soil by the roots is very great. It is not well known how much passes back to the roots, or how much passes through the leaves into the air, but all experiments show that very much more passes off through the leaves into the air, than runs back through the roots into the ground again, as is shewn above. The provision made for evaporation when necessary, and for absorption when necessary, in leaves is immense. In the leaf of the lilac for instance, as elsewhere noticed, there are one hundred and sixty thousand openings for the purpose to the square inch. By these, when the tree needs it, it throws off; by them, when it needs, it obtains moisture from the air again. It may be well here to say that, as regards the amount of water absorbed, in case of need, by leaves, science has not as yet been able to give us such clear proof as it has furnished concerning the amount given out by them. The last is certainly immense. The former exists; but is as yet unmeasured. In some trees the upward rush of moisture from the roots is very powerful. The workmen in shipyards frequently find in the centre of a teak log a core of sand fifty or sixty feet long, an inch in diameter, and hardened to a marble-like consistency, which has been carried and deposited there by the sap in its upward course. One main conclusion, we will, for our purpose at present, notice—that the volume of moisture passing into the air from the leaves of trees must be extremely large.

HOW MOISTURE IS RETAINED IN FORESTS.

The whole forest, in its natural state, forms a reservoir admirably fitted to receive large supplies of moisture, to hold it for a lengthened time, and to part with it at intervals well calculated to benefit the vegetation of the surrounding country. The bed of the forest is a widely spread surface, piled thick with leaves, twigs, pieces of fallen branches and remnants of decayed logs, covering another layer of the same substances, in a state of partial decomposition, overlying yet another strata completely decomposed, altogether forming a deep porous hollow framework, penetrated with a myriad of pipes, tubes, and aqueducts, and interspersed with millions of miniature cisterns. Then, every hollow on the surface is obstructed by fallen and rotting logs, blocking and holding in position the flow of water until the humus below fully absorb it, while the whole surface of the earth is crossed, recrossed and crossed again by a chequer-work of partially elevated roots, the box-like openings between which perform the same function. If we go below

the surface we shall find the solid earth beneath the mass of vegetable decomposition pierced everywhere with upright and porous pillars of wonderful tubular structure—the large and perpendicular tap-roots which many trees possess, passing deep into solid clayey strata otherwise impermeable, and sending through the triturated earth which surrounds them, a slow and steady supply of water to a thousand subterranean and spring-feeding channels, which, travelling away from the forest and under the cultivated fields, supply the great lower bed of moisture, that continually rising, fertilizes the upper soil, and finally passes off to find in brooklet, lake or river, their course to ocean again. On this great natural bed and reservoir, rain may fall in torrents, only to be held there in suspension till it gradually, and in such degrees as are best fitted to promote the beneficial work of nature, flows away in curving creek, in rippling rivulet, nourishing and feeding the thirsty earth as it goes. On this same great bed, vast mountains of winter snow may pile themselves, protected by the overhanging branches and dense thickets of underbush, against too rapid thaws in Spring, thoroughly moistening and soaking the whole great mass of humus and roots, and furnishing a vast field for evaporation ready to part with its watery treasures to the surrounding atmosphere, at the fervent bidding of the warm sunbeams of April or of May, the period when vegetation needs them most—the period for which nature has stored them and at which she delivers them, and the period, if you notice, at which she takes care no dense foliage obstructs the action of the sun. Then, reversing the process, when in times of drought, the forest bed has parted with its surface treasure of moisture, the deeper roots can and do draw, from the subterraneous and concealed channels, a vast supply for the trees themselves, which again passes through the leaves into the air, and falls in rain or dew.

Let us view the forest under a different aspect from that which is open and apparent to the natural eye. Let us consider that great portion of its actual being, life and functions which are carried on by means of water. This forest, with all its ponderous trunks standing around us, solid, firm, impermeable, has been in its day, from root to leaf, but water, gases and vapour, and is still but a channel for their passage, the passage by which its existence is continued, its growth fostered, its death in due time obtained and its reproduction secured. The forest is a river; deep around its interlacing roots the joining waters fill everywhere the land, they separate, they mount in every trunk continually in upward flowing streams, they separate again in their course to every branch and every leaf, they again separate in their passage to the outward air through the thousand openings in these; they join the air, they form a dense and vapour-saturated atmosphere above the forest top, above the whole far-spreading and wind-tossed sea of glittering leaves, and they rise perpetually a body of innumerable tons of invisible water, cool and damp from the forest depths, to meet the coming south-west wind bearing its liquid treasures fresh from the warm equatorial region, treasures of moisture rich as that of the forest exhalation, far more extensive but far more heated than their's. They meet, and the junction of the differently heated masses necessarily precipitates both in rain; it falls to the ground; it may pass by innumerable channels to the distant ocean, it may rise to the nearer atmosphere through wheat, through grass, through forest leaf again. Every forest is an immense fountain of water rising perpetually from earth to sky, falling ever from sky to earth again.

MOISTURE SUPPLIED TO THE AIR BY FORESTS.

The forest land being always shaded, by the dense masses of foliage above, from the summer sun, is then much cooler than the surrounding earth of the open country, a coolness increased by the damp atmosphere within and surrounding it, produced by the exhalations of the leaves, by the droppings of the great accumulations of dew, which collect on its great extensions of leaf surface in the course of the night, and by the evaporation from the ground itself, which, as before observed, is almost a perpetual bed of moisture. The amount transpired by the leaves, as shewn in the preceding paragraph, is enormous. The forest then is continually sending out and sending upwards, dense accumulations of vapour. It necessarily sends them upwards, the vapour of water being the lightest and most inclined to rise of all vapours. Therefore, there will be above the forest a large stratum, or it may be a column of air holding in solution as much vapour of water as it can bear, without forming cloud, and ready, when the proper natural cause occurs, to form a cloud, and thereafter in due time to be precipitated in rain. What may occasion this we will speak of further on.

MOISTURE INCREASED BY PREVENTION OF WINDS.

Another cause which adds to the moisture in the field surrounding a forest is the great influence it exerts in modifying the force of the wind. When the stratum of air immediately above the fields has, in drying the fields, taken up a portion of its moisture, that moisture will pass off slowly to the stratum of air above, and that in turn to the next above; but if the stratum of air next to the ground be rapidly moved across the ground by the wind, it is no longer simple evaporation into one stratum, that portion of stratum moves off immediately with the wind, and is immediately succeeded by another portion of the same stratum, and that by another and another as rapidly as they can pass over the ground, each in turn, taking what moisture it can rapidly imbibe. Therefore, a portion of country protected by an adjoining forest from rapid winds, may remain, although exposed to sunshine, for weeks, in good moist and growing condition, while a rapid drying wind passing over it for even one day, might have taken from the ground much more moisture than it could spare, and have very injuriously affected the crop. To prevent this is one great use of even very thin lines of trees.

THE GREAT NATURAL SYSTEM WHICH GIVES RAIN IN DUE SEASON.

Providence gives man the means, if he choose to avail himself of them, of procuring all through the growing season, frequent growth assisting showers. The means are given him of continuing and preserving to himself thousands of rivulets, "the upper springs and the nether springs," so that few good sized farms need be without a creek or spring in some corner or another, where you may always be sure of water for your cattle, without having to spend hours a day pumping it from a well, and not getting then a constant supply, or one nearly as healthy as the stream; without having, when wells dry, to drive your cattle across your neighbour's fields, meeting his black looks, because he is sure it is you who leaves his bars down, and moreover he don't calculate he'll have more water than

he wants, and “doesn’t believe he contracted to supply the country,” without, worse still, having to tramp after your beasts three or four miles along the dusty roads to a creek. Or, if you have plenty of water, and your neighbours none, it is hard to say whether you are much better off. If you supply them you are a thoroughfare without a toll-gate. If you refuse, you are a tyrant, and are informed over your fences that “there will be water when you’re dead and maybe you’ll want it yourself before you die.”

More, the water which supplies moisture for the crops comes largely from below. It is not because the rain fell on the herb of the field that growth chiefly proceeds, though that does good ; but it is because the earth received the water, and the great underground system of natural pipes and channels has obtained its due supply. If, during the shower, some malevolent giant should hold his umbrella completely over your farm, his spiteful intentions would be, in large measure, frustrated, for the whole network of channels, which everywhere tunnel the soil—millions invisibly small—millions conveying vast quantities—would have all over the land received their share, and your land would receive from below some compensation for what the overgrown gentleman had kept off above. It is this underground store, which, in a dry time, sends moisture up to the roots, and thence to leaf and twig. The dry board lying on the ground will split and crack in the sun—the pitch will boil out of the seams of the upturned boat—the rock will glow till it will nearly burn your finger ; but the plant will not—it is cool, green and moist long after all around is parching. It has had no rain ; it may not flourish, but it does not die. It has other means of obtaining moisture, and one of them is by drawing through its roots from below, water, which, it may be, fell in rain two months before, has been preserved on forest floor or subterranean cavity till now, has now in its turn passed on its course to the sea, and in its way preserves from death the growing herbage till the rain from above give it of life a new and a firmer hold.

If my readers will travel with me a little way on a very dusty road of dry technicalities, we will endeavour to find a clear explanation of what brings rain, and what causes the winds which bear the clouds along. Let us here remark that when we see a cloud apparently come with the winds, we need not be sure it came at all. That cloud may have been above us in *propria persona*, but we could not see it. The air may have had much water in it which we could not see ; the wind may have brought sufficient cold to condense the moisture, when we could see it at once. The *cloud* in that case did not come. The means of changing it into visible form came.

A writer says in relation to a certain storm in India :—“ Previous to such a down-pour of rain the heavens were perfectly clear, without a cloud to be seen ; yet there, it may be, the whole of that moisture was suspended, dissolved in the air. The rain cloud may have appeared to proceed from beyond the horizon, and to come thence, advancing with resistless force, borne forward by the gust of wind, more like a tornado than aught else ; but there are reasons, and these satisfactory ones, to warrant the conclusion that the cloud had not been blown thither by the blast, but had been formed at the various points of its advance by the wind suddenly cooling down the air below a temperature at which it could hold the moisture in solution, very much as is the case with the sand and dust filling the air immediately before the falling of the rain ; whatever proportion of these may have been brought from a distance more or less remote, most of it may have been seen raised from the ground on the spot as the mighty rushing wind passed on in its course, and the little lapse of time between the appearance of this precursor and the precipitation of the rain was only such as was occupied in the aggregation of the rain

particles into the larger drops which fell, and the precipitation of these by gravitation and by the blast, aided, it may be, by the co-operation of electric force, the process being essentially the same whether the blast have come on as an onward moving cold wave or have advanced as an advancing whirlwind which raised the air through which it passed to an elevation at which, it may be in consequence of sudden expansion, the temperature was too low to retain all the moisture in solution.

"With the copious evaporation going on from the leaves of a forest, there is nothing surprising in any change of wind producing a cloud or mist above a forest, where formerly the air had been perfectly transparent, and everything known in regard to such phenomena makes it probable that in general, if not invariably, the cloud is produced there, and not attracted thither by the forest."

Let us go on with the explanation, premising that it is founded on the one given by Herschel, and published in the "British Encyclopædia;" that it has been adopted by Flammarion, one of the leading French meteorologists, who published an exhaustive work containing it in 1879; and that this work is edited by Mr. Glaisher, one of the leading British authorities of to-day.

It is as follows:—At the equator, where, as we all know, it is always very warm, the broad heated ocean sends up, as is the nature of water when heated, vast quantities of itself in the form of vapour. At the same time the air there is always being heated, and rises as the vapour does, with great force, but not with nearly so much as the vapour. Vapour of water is the lightest of all known vapours, and except hydrogen and ammonia, the lightest even of gases. How much lighter than air it is you can see for yourself, if you notice how fast it climbs through the air from the pot to the ceiling. True, the air has not quite its chance; it, too, would climb fast if it were hot. But heat it as you will it could not climb like that. Now, the quantity of water sent into the air in the tropics by evaporation is immense. It is calculated that throughout the whole great equatorial region there rises thus annually a body of water sixteen feet deep. That is over half an inch a day. That does not sound large, but it will sound larger when you think how it grows. Turned into vapour, even at only fifty degrees temperature, it takes a space many thousand times larger than before, or some thousand feet high over the whole region. Add to this that the air it has been forced into when thrown upwards from the ocean is itself expanding largely, and therefore becoming lighter and rising also, you will see that there is an immense body of air and vapour being sent upwards very rapidly and constantly over the whole great equatorial region. Now this uprising leaves no large vacuum of its own size, as a body of that dimension would if sent upward in some circumstances. There is no vacuum left whatever, for the water is below and continually affords fresh vapour. But north and south there is abundance of air; air, too, which has not been heated as has that of our central body which is going up; and as the central body over that vast space—remember we are speaking of a belt round the world thousands of miles wide—as it gets heated, rarefies and rises, the great cooler and more solid bodies of air north and south rush in, themselves become dilated in the scorching heat, and rise upwards in their turn along with the immense volume of vapour, which being still more inclined to rise than they are, hurries them aloft; so that at the equator, or rather in the great equatorial regions, are two great masses of air rushing from the temperate regions, north and south, towards the equator, meeting, rising, and going upwards together with the vapour arising from the sea.

We will here pause to take into our calculations another item. These winds (these two north and south coming masses of meeting air, form the tradewinds, as they are called. These winds, though starting to go from north and south towards the equator, do not get there as north and south winds ; for the earth keeps turning round from west to east, so that on the north the tradewind is a north-east wind, and on the south its meeting tradewind is a south-east wind. These came, we remember, from the temperate zones, leaving of course a space there which is instantly occupied by another mass of air rushing in from the polar regions north and south.

Now we will follow our meeting tradewinds upwards from the equator. Forced upwards above the surrounding strata of air, beyond the levels of equilibrium, they flow over to north and south towards their respective polar regions. These are the anti-tradewinds, and they are acted upon by the earth's rotating movement as are the tradewinds before mentioned, so that these returning currents blow from the south-west in our northern hemisphere, and from the north-west in the southern hemisphere, always, however, towards the poles and from the equator. Near the poles, they approach the point whence the polar air started to move towards the equator, to fill up the gap occasioned by the rising equatorial air (or rather, there is no gap, but to prevent the gap which would have been had they not pressed in). Well, at this point near the poles they, as fast as the polar air starts towards the equator, press into its place, follow it, go to the equatorial regions in the tradewinds, rise up there and come back again to the poles in the anti-tradewinds, and the current is complete.

Now, at first the anti-tradewinds coming back towards the poles keep high in the air, so that they and the tradewinds below, going towards the equator, are quite separate ; but once past the tropical circle they come down near the earth and blow towards the poles on the same level as the tradewinds coming from the poles. They are therefore upon the same level, and kept asunder only by the rotating action of the earth. There are, to quote Flammarion, "points at which these two currents come together, and their different qualities cause numerous and sometimes disastrous atmospheric disturbances. Their beds get shifted over the surface of the globe, and the succession of one after another in the same place produces sudden variations in the state of the sky." To avoid confusion they are, from the point at which they flow on the same level (where, I mean, the anti-tradewind above flowing towards the poles, comes down to the same level as the tradewind below blowing from the poles), called no more trade or anti-tradewinds. The anti-tradewind is from here to the poles called the equatorial current of air, and the tradewind the polar current of air.

You will remember that in our northern hemisphere the anti-tradewinds returning from the equator blow from the south-west ; the tradewinds coming from the poles blow from the north-east. We will remark, therefore, in passing that the equatorial current must, as being laden with moisture risen from the tropic seas, be humid, warm, and bring much moisture with it, while the polar current, coming from the arctic regions, will be cold and dry. But these two currents are varied in their moisture-bearing capacities by many local and other circumstances ; great mountains condense their moisture ; the warm Gulf Stream has much to do with evaporation in its course ; great stretches of prairie and of woods cause differences. Here, for instance, in Toronto our Observatory records would

give the humid winds as ranging from east round to south-west, largely south-east. This is explained by some who have given thought to the subject as being caused by much moisture passing from the equatorial current, high above us, into lower currents blowing other ways, by the fact that the Rocky Mountains deprive the west wind of much moisture, and by the passage of moisture here across the Atlantic States from the warm Gulf Stream and the Gulf of Mexico. Many acute observers, however, hold strongly to the south-west wind being the rain-bringer. Still from the equator, one way or another, but of course from the south, most of our moisture comes. It may be here remarked that in order clearly to comprehend the motion of the winds, it is well ever to keep in mind the fundamental law, that all movements of the atmosphere are in consequence of the property gases possess of being expanded by heat, and that the heat of the sun keeps all in motion.

Here is an instance, from the meteorologist Spang, of the meeting of these two winds forming whirlwinds :—

“The polar current, in its course towards the south, held in suspense by the equatorial or warm current, may be compared to a body of water confined by a dam, except that the dam has here also a positive force, and if released, a motion of its own. If this aerial dam is broken at some point on the surface of the earth, the air of the polar current above the break will sink into it, and there will be formed in its upper region a depression or trough corresponding to the break. That portion of the equatorial air which has opposed the sunken polar air will rush with great force into the depression, and produce an eddy or whirl, and cause a rotary storm and a cloud to be formed which assumes the form of an inverted cone. This cloud is formed by the sudden and profuse condensation of the moisture contained in the air of the equatorial current, which is thrown suddenly into higher and colder regions, and sometimes the temperature is so greatly reduced that the vapour, after being condensed freezes, and hail is formed by the centrifugal force of the rotary storm.”

The two winds just described may be said to be the only two winds in the world. All the rest are but modifications of these, occasioned by what may in comparison be considered local causes. The different divisions and apportionments of land and water here and there cause many inferior rarefactions and condensations, which produce all the varied phenomena of tempests, hurricanes, gales hither and thither, which continually take place. This forms a chief part in the great plan of Nature. By this many movements necessary in fitting this world for the habitation of beings like ourselves, are set in operation. One very important one, which we shall frequently have occasion to notice, is that by this means is borne upwards from the equatorial seas and towards the poles that vast mass of moisture previously described. It does not of course all go as far as the polar regions, though a great portion does. Much falls back in rain in the tropics, and much on the way north and south. It may be here observed that no doubt large evaporation of water is continually occurring elsewhere, on ocean, lake and river, and on land as well as in the tropical zone. But the last is the chief source of supply. We will now leave this part of the subject and go on to another intimately connected therewith, which is necessary to be considered before we can make further headway.

THE PRODUCTION OF RAIN.

To quote from the excellent author I have just mentioned, "The water is not motionless either in the depths of the oceanic basin, in the solid ice, or in the atmosphere. Thanks to the always active power of the sun, to the aerial currents, the water rises vertically from the depths of the seas to its surface, becomes vaporized at all temperatures, ascends in the shape of invisible vapour through the ocean of the air, becomes condensed into clouds, travels across continents, falls again in the shape of rain, filters through the surface of the soil, passes along the strata of impermeable clay, springs up as a source or fountain head, descends by the streamlet into the river, and falls from the river back into the sea again."

The vapour of water, as we have seen, rises from the ocean, mingles with the dilating and arising air, and in immense quantities ascends into the higher regions of the atmosphere.

Will my readers now for a moment study this little table. It is but nine lines :—

At 14 deg. a cubic foot of air is saturated with water by the weight of 1 grain.

30	"	"	"	"	2 grains.
41	"	"	"	"	3 "
49	"	"	"	"	4 "
56	"	"	"	"	5 "
66	"	"	"	"	7 "
80	"	"	"	"	11 "
88	"	"	"	"	14 "
100	"	"	"	"	20 "

When we thoroughly comprehend the effect of the fact stated in this table, we understand why two clouds or two currents of air more or less saturated with vapour of water, coming into contact at certain temperatures, produce rain. It occurs in the following manner :—

We will notice that a foot of air at a temperature of one hundred (the heat of a very hot day indeed) will hold twenty grains of water. If it were only at thirty degrees it would hold but two grains of water. Now let us suppose a mass of a thousand cubic feet of air at 100 degrees, and holding twenty thousand grains of water. Well, a cold current of air comes along, meets our cubic mass, and cools it down to thirty degrees. It can only hold two thousand grains now ; the cold current has served an ejection on the odd eighteen thousand grains, and they must fall out. They would fall out first into cloud, then into rain, and that is a rough sketch of the way in which rain is produced.

But we will go more slowly, and first show how a cloud is formed. Here are the words of an excellent writer on the subject, so concisely put and so clearly, that we cannot do better than copy them :—

"The *invisible* vapour of water spread through the atmosphere becomes *visible* when a decline in the temperature or an addition of moisture brings it to the point of saturation. Suppose, for instance, that a certain quantity of air at eighty-six degrees contains 478 grains of vapour of water, this air will be quite transparent. If by some cause or other this air descends to seventy-seven degrees, or receives an accession of moisture (either will do) it will become opaque. If it is done by the lowering of the temperature, a diminution of nine degrees of heat will cause 108 grains of vapour of water to be condensed and to become visible. This is what a cloud really is : vapour of water which the

air, being saturated, is no longer able to absorb, and which becomes separated from it by passing into the state of small vesicles."

This is the way clouds form, and, as you will see by the following, it is but by a continuation of the same process they are precipitated in rain. If the cold current which has produced them from the warmer atmosphere continue to exert its condensing force, or if a more saturated current arrive, the process goes on, and now becomes molecular ; that is, the larger particles rapidly come together in still larger ones, the force of gravitation begins to be felt, and the whole process is described by that great meteorologist, Herschel, as follows :—

"In whatever part of a cloud the original ascensional movement of the vapour ceases, the elementary globules of which it consists being abandoned to the action of gravity, begin to fall. By the theory of the resistance of fluids, the velocity of descent in air of a given density is as the square root of the diameter of the globule. The larger globules, therefore, fall fastest, and if (as must happen) they overtake the slower ones, they incorporate, and the diameter being thereby increased, the descent grows more rapid and the encounters more frequent, till at length the globule emerges from the lower surface of the cloud, at the vapour plane, as a drop of rain, the size of the drop depending on the thickness of the cloud-stratum and its density."

Now, if my readers have but followed these learned gentlemen through their technicalities they have grasped this plain fact :—Rain is the precipitation from the air of moisture which was more than it could, at the degree of heat to which contact with a colder stratum of air had reduced it, hold in solution. And to show how elevations, especially if wood-crowned, produce rain, any one can also easily see that if a saturated current of air arrive at a mountain chain or other height, and have to rise into the colder atmosphere above, getting colder one degree, according to the season, as they rise 200, 250 or 330 feet, as the air is the colder the higher we ascend, it must in consequence part with, as rain, much of the moisture it carries. Let us remember, too, that rain differs from cloud only in being formed of drops produced by the mutual attraction of lesser drops, which rapidly fall by force of gravitation to the earth instead of floating, as the smaller particles of moisture composing the cloud had been, in the air.

DEW.

We will now travel onwards to another important point, and will do our best to observe the operation of dew. To understand this we have simply to remember that the earth's surface is heated in the day by the sun, and gets much colder at night, the heat it has obtained being what is called radiated off. Some objects cool in this way much more than others, some leaves of plants more than others. Whatever it may be which cools these, these cool the air next to them, and produce the same effect as the cold stratum of air we have just been speaking of in connection with clouds ; (when it strikes the warmer stratum, that warmer stratum is cooled so much that it cannot hold all its moisture, and cloud is formed, and afterwards, if the process be continued, rain) ; so the grass, the leaves, paper, glass, wood, all these cool quickly by radiation, form the cool stratum here and compel the air close at hand to part with its moisture to them. We see it in the morning covering them in the form of drops and call it dew.

Let us for a moment consider what the dew point is, a thing frequently mentioned in relation to this. It is the point at which the air is saturated with moisture to the extent of all it can hold at its then existing degree of heat. If it be cooled it must lose moisture. Now our knowledge of dew on the forest leaves is principally given us by a learned gentleman called Meguscher, who says :—

“Whenever the temperature of the air is above sixty-seven degrees Fahrenheit, the temperature of the tree will be, to the extent of the excess, lower. If the temperature of the atmosphere be ninety degrees, and the dew-point seventy-five degrees, there will be a copious deposit of dew, and if the lower temperature be the consequence of radiation, the deposit may be expected to take place over the whole of the upper surface of the leaves, in the aggregate, according to Humboldt's measuring, several thousand times the area of the ground they cover.”

Baron Humboldt's statement, to which this refers, is so clear, concise, and yet elaborate, that I cannot refrain from giving my readers; in full, at least this one small gem from the innumerable brilliancies of this great traveller's writings. He was one of those always successful writers who are successful first that they see, at any cost of travel, all that is possible concerning they mean to tell of, and next, know how to tell it. He says :—

“The forest region acts in a threefold manner—by the coolness induced by its shade, by evaporation, and by the cooling process of radiation. Forests uniformly composed in our temperate zone of ‘social plants’ belonging to the families of the Coniferae or Amentaceae (the oak, beech and birch), and under the tropics composed of plants not living socially, protect the ground from direct insulation, evaporate the fluids they have themselves produced, and cool the contiguous strata of air by the radiation of heat from their leafy appendicular organs. The leaves are by no means all parallel to one another, and present different inclinations towards the horizon, and according to the laws established by Leslie and Fourier, the influence of this inclination on the quantity of heat emitted by radiation is such that the radiating power of a given measured surface a , having a given oblique direction, is equal to the radiating power of a leaf of the size of a projected on the horizontal plane. In the initial condition of radiation of all the leaves which form the summit of a tree, and which partially cover each other, those which are directly presented towards the unclouded sky will be first cooled.

“This production of cold (or the exhaustion of heat by emission) will be the more considerable in proportion to the thinness of the leaves. A second stratum of leaves has its upper surface turned to the under surface of the former, and will give out more heat by radiation towards that stratum than it can receive from it. The result of this unequal exchange will then be a diminution of temperature for the second stratum also. A similar action will extend from stratum to stratum till all the leaves of the tree, by their greater or less radiation, as modified by their difference of position, have passed into a condition of stable equilibrium, of which the law may be deduced by mathematical analysis. In this manner, in the serene and long nights of the equinoctial zone, the forest air which is contained in the interstices between the strata of leaves, becomes cooled by the process of radiation; for a tree, a horizontal section of whose summit would hardly measure two thousand square feet, would, in consequence of the great number of its appendicular organs (the leaves) produce as great a diminution in the temperature of the air as a space of bare land or turf many thousand times greater than two thousand square feet.”

Taking this and the preceeding paragraphs together, we must be aware that the forest absorbs much moisture from dew, which will either fall in drops on the ground, or be disseminated in the whole atmosphere within and above the forest. All that falls within or stays within is safe from the sun's drying power. So with whatever rain may

fall on the forest, it soaks into the spongy bed of the ground, renewing that deposit of moisture which in winter the snow had kept fully supplied. The snow was kept there in the partial shade of the branches, the water melting from it kept by the peculiarities of the surface—that soil of the forest already described, with its roots, logs, and inequalities—till spring was advanced and yet a good supply of moisture remained for summer. Then comes the rain, and is stored like the former, while night after night the dew adds its share and assists in maintaining the great forest bank, on which the thirsty fields for miles round perpetually draw, and perpetually, too, return back honestly that moisture which they have borrowed. So long as the forest is left in fair amount, field and wood act, in reference to supplies of water, like a great self-regulating and compensating machine. But when we destroy one part of the engine, we do not find it to work (and no wonder) so beneficially or so smoothly as before.

The moisture in forests is further increased by that obtained from mists, which are, in fact, clouds forming near the earth. The particles in these are not yet large enough to form drops of rain, and are, till further condensed by change of temperature, kept apart by the nature of their present support in the air. But, as when one is passing through a fog, the water collects on the beard and on the clothes, so with trees, though the particles of moisture in the fog be so small that a heated wind (rising the temperature, which, as before explained, renders the air capable of taking in more vapour of water) might have absorbed and carried it all away again. Yet all which touch the innumerable leaves stay there, coalesce there, run together, and fall to the ground.

It must be remembered with relation to dew on forest leaves, that there is a vast transpiration frequently going on from them, which must interfere somewhat with the deposit of dew on the same leaf. This transpiration, which will be shortly described, takes place while the tree is warm, that is, uncooled by radiation, and continues till far on in the night. It becomes more feeble, as various writers state, from the leaves of plants of all species, when covered with dew. This is inevitable; the leaf must cool to form dew; it is before cooling that transpiration is most active. It must also be remembered that except in case of leaves such as water-lilies, which float, the openings—the *stomata*—are largely on the *under* surface, thereby interfering less with the operation of dew-forming.

The reader will find it worth while to study these three or four paragraphs by an acute writer relating to the same subject:—

“The clouds occasionally seen over woods, while the atmosphere around is comparatively clear, are consequent on the condensation of the humidity occasioned by the evaporation from the leaves.”

“There is always moisture existing in the atmosphere; it is reckoned one of its constant constituents, but it varies in quantity. The quantity is minute compared with that of the oxygen and nitrogen of the air; but it is never absent. There it is, on the highest mountain and in the deepest mine; on the ocean’s surface and on the dry land a thousand miles away.”

“The quantity of moisture passing into the atmosphere from the leaves of a forest in active vegetation must be considerable. Calculate the number of *stomata*, or stomates, on a leaf, multiply this by the number of leaves on a branch, the product by the number of such branches on a tree, and the product of this by the total number of trees in the clump, or the total number of trees in the forest, and the final product will indicate the

provision made for evaporation from the forest. There are similar stomates on every verdant plant on the dry land; but the evaporating surface supplied by the leaves, rising tier above tier, far exceeds in extent that supplied by the herbage and the grass growing elsewhere; and in many places these may be found growing as luxuriantly on the soil of the forest as in the fields beyond, or perhaps more so, and adding their quota of evaporation to the evaporation from the trees."

"Of the moisture thus raised by the tree, and no longer required when the sap has been elaborated in the leaf, the air will only take up what quantity it can, at the temperature at that time and place, dissolve and hold in solution; and cases have been cited in which the excess is so great that the leaves seem to act as alembics, distilling water which falls in great drops to the ground.

"Where this does not take place, what the air dissolves it will hold in solution so long as the temperature is maintained at the same or a higher point; but if the temperature fall below the point at which it can do this, what it cannot sustain as invisible vapour, will be deposited or suspended in the form of mist, or cloud; and such a reduction may follow the setting of the sun, or even the decline of it in the afternoon and towards nightfall; or if there come over the trees a wind in any degree colder than the air in which they are enveloped, the air is thereby cooled down, and a quantity of the moisture which it held in solution may be deposited in the form of fog, or of dew, or of rain."

The same writer shows us another remarkable effect of the soil of forests:—

"A distinction has been drawn between the effects produced on the ground by the shade from sunshine, and by the shelter from drying winds afforded by trees and forests. It is necessary further to distinguish between the effects produced by shade and by vegetable mould, which exists always in greater or less quantity in forest soil, in consequence of the decay and decomposition of fallen leaves and fallen twigs, and broken or decaying rootlets.

"In the soil of a forest there generally exists more moisture than can be attributed to shade, or to shade and shelter combined; and much of this is attributable to the attraction of moisture manifested by this vegetable mould.

"In this effect of vegetable mould we see how forests may exercise a third influence, over and above and distinct from both shade and shelter, in maintaining a humidity of soil."

From what has been so far stated concerning the forest, my readers will have seen that it is a great storehouse of moisture, so long as its natural bed and foundation be preserved from the injuries occasioned by cattle and running fires, and while it is reserved in sections of sufficient depth and width, to thoroughly maintain its forest character, and establish decided variations between its temperature and that of the cleared land. They will have seen that that moisture will in such case be continually renewed from the depths of the earth to which the tap-roots pierce, in addition to the larger supply received from the clouds above. They will have seen that the sun's rays cannot again carry off this moisture when it is once within the forest wall. They will have seen that the wind, which dries faster than the sun, and extremely fast when it has the sun to help it, cannot dry the land in the forest. That the moisture thus kept in the forest is used to feed the rivers, streams, creeks, and springs, and to keep up the whole underground system of water below the fields; and also, and in very great part, to carry up nourishment from the roots to the leaves, escaping in vast volume thence to the higher atmosphere through the not innumerable altogether, for they have been counted; but through the wondrously numerous openings in the leaves (160,000 sometimes to the square inch; the most

complete little contrivances imaginable, with a door and hinges to each, and full power to shut or open them, all as the tree needs). Stop one moment, and notice that when the leaves are cool, and dew is forming on them, as it would on any dead substance which cools by radiation, these doors can be shut. When the tree is warm with life from the sun again, they can open, and transpiration (as the out flow of vapour from the leaves is called), or absorption of moisture if the tree need it, go on in full vigour. We cannot do better, to interest ourselves in the operation, than to read the description written by a distinguished gentleman of France (the Marshal Vaillant), who made it a special study, and gave much time to experiments connected therewith. He says:—

“Even the most humble plants, such as chickweeds and meadow grasses, evaporate considerable quantities of water.

“If from herbaceous plants or modest shrubs we turn to our large forest trees, we may expect that, compared with the weeds of which we have just spoken, they will transpire a large quantity of water, which is probably in proportion to the number of leaves and their extent of surface; and it is our belief that this summer function of the leaves is carried on by the trunk and branches during the whole year.

“From whence comes the water so rapidly transpired by the foliage? Certainly from the soil.

“I placed in a large jug of water, tightly closed up to hinder the natural evaporation of the water, the end of an oak branch, five feet long and nearly an inch thick at the butt. It was cut from a tree eighty feet high and three feet thick. In three days it had lost thirty ounces of water.

“If we believe that all the leafy part of a tree will act, as regards the faculty of transpiration, like the leaves of the above-mentioned branch, we arrive at the astounding result that an oak like the one described will in a summer day cause the evaporation of more than 440 gallons of water.

“I am not decided as to the value of my experiment, and see that my deductions are not free from objections; but it must be allowed that supposing even half or one-quarter of the estimated quantity be omitted, the quantity must greatly exceed what might have been expected.”

Let us use the excellent Marquis's experiment, and draw our own inferences, which will put us, probably, in a position a step farther advanced. The branch with its leaves, no doubt, sent off this vast proportion. But branches on trees probably do not. If my readers will remember what is previously stated about the mouths of a tree (the spongioles, as they are called, at the ends of the roots), they will notice that these take in as much water as the tree needs to carry up its nourishment and act as its vehicle to the leaves, where all water not needed is sent off by transpiration into the air. Now the leaves, it may be supposed, having no such functions, not being the sentinels at the root gates, may transpire while they live as much water as is sent up to them, and we may suppose the transpiration machine working furiously, when the Marquis had cut off the connections with the roots, as a steam engine with the regulating valves left unattended.

They would, no doubt, take it in at the severed end of the branch, and send it off by the leaves. But though the forest draws much up, and transpires it, this experiment does not prove that it draws up the enormous quantity spoken of.

Taken with this understanding and qualification, however, we can well believe the rest of the Marquis's comments, which are in fact generally adopted as correct by meteorologists, and of which Mr. Crombie Brown, a high authority, thus speaks:—“With

regard to the main fact, that the emission of moisture by the leaves of the forest is very great, we are at one."

The Marquis's views thus largely corroborated are:—

"It is an accepted fact, and not without reason, that the neighbourhood of forests is cold and damp. This is far from astonishing when one thinks of the enormous volume of water transformed by forests into vapour, and the quantity of heat absorbed in this transformation. This heat must have been obtained somewhere, perhaps from the soil of the forest and that of the neighbourhood.

"In the same way there should be great damp in the neighbourhood of forests, especially when the temperature is high, and it cannot be otherwise, on account of the enormous amount of water in the form of vapour which is discharged by forests into the adjacent atmosphere.

"This vapour is emitted in much greater abundance during the day than during the night. Towards night, a little after sunset, when the general temperature begins to fall, the transpiration not yet having time to slacken, and ascending into a colder air changes into visible fog, like our own breath in like circumstances, and this fog in its turn becomes a cloud on the following morning, when the sun warms its particles; but whether clouds or fogs, they will be carried away by the first breeze to descend in showers.

"If these details as to the formation of forest fogs be correct, such fogs should be more frequent in calm weather, when the air is naturally more moist and especially when the contract is greater between the cool of the evening and the heat of the day. The test of conditions for the formation of thick fogs is especially complete, at least in our climate, towards the end of summer and the first half of autumn; and it is during this period that the phenomenon is most frequent and noticeable.

"If the transpiration carried on by the leaves were coloured and perceptible, it would be a grand sight to see great columns of vapour ascending majestically into the air, diminishing by their heights the distance between the tops of the trees and the stormy clouds; and as this vapour facilitates the passage of electricity, by increasing the moisture of the air with which it mingles, the facility with which isolated trees are struck with lightning can be accounted for."

If my readers have followed me, and we have succeeded in arriving at a clear explanation, we will now have had:—

1. A short account of the manner of growth of a tree.
2. The system of the winds and their method of conveying moisture.
3. The causes of the moisture being precipitated and falling to the earth as rain.

We will now proceed to notice:—

THE CONNECTION OF FORESTS WITH THE PRODUCTION OF RAIN.

We have observed that the winds returning, charged with heat and moisture, from the equator in their course to the north pole, bear with them an immense quantity of water. As has been said, the torrid seas send their surface, sixteen feet deep, to the skies in the form of vapour in a year. Of this it has been computed that six feet are discharged in rain in the tropics, the remainder sent towards the poles, towards the north pole about six feet—a tremendous mass of water. In addition, we must remember, vast though lesser amounts of water, are taken up from the rest of the surface of the world, both land and sea, and though the south-west winds, evident or concealed by changing currents, must be our chief supply, yet water-charged clouds from other sources pass over in all directions as well.

From abundant proof and many observations, as well as from the natural reasoning concerning what must be the case under such circumstances, it is evident that there is arising from forests a vast amount of vapour of water, which, as we have seen, is the lightest of vapours. This vapour will necessarily be cool, as is the forest region from which it comes.

The winds bearing moisture coming from the south will not be generally as cool. These, meeting the ascending streams of cool and moist air arising from a forest region, must be deprived thereby of their power of holding a great part of the water they carry, which must shortly descend in rain near the place of conjunction, according to the temperature of the approaching wind, and the amount of water it bears.

Thus we have the chain of proof, and the direct influence of forests in securing rain during summer given in its completion. Spring and summer are the seasons when the internal functions of trees are in their greatest activity; then is transpiration most active; then rise from them most columns of humid air towards the clouds. Spring has not so many leaves, but then the sun pierces the forest, and draws from the ground—the bed of moisture, as before explained—an amount of vapour many times greater than the fields can afford. This cool vapour, rising and meeting the south, south-east, or south-west wind forms rain. And these seasons, spring and summer, are those in which rain is most needed by the thirsty fields and the growing vegetation. This is the value of woods to the farmer.

We have now gone over the complete system of transpiration of moisture by wind throughout the atmosphere from equator to poles and back to the equator again. But it was also remarked that there were many important circumstances of local origin which produced local results in the distribution of moisture and the arrangement of climate. To us in the Province of Ontario there are existing very important local circumstances indeed, which undoubtedly have a great influence, that is to say, the presence of the great lakes. Our chief reservoir of moisture, as is that of all the world, is the equatorial ocean. But our lakes also greatly help, and there is no doubt that their presence largely contributed to the establishment of the splendid forests we have destroyed, and to the accumulation of the layer of rich land on which those woods rested. We cannot do better than now to call to our assistance the aid of a gentleman who has given, as far as I can find, the best explanation of these local phenomena, Dr. P. H. Bryce, M.A., of Toronto.

But before reading this it would be well to study carefully the few pages following, here, after which the other as connected with these great principles, will be much better comprehended. The article is from the world-renowned pen of Herschel, and is fully in accord with the explanations of writers of a late date:—

Of Land and Water as Recipients and Communicants of Heat.

“Of the solar heat which actually reaches the surface of the globe, that which falls on water penetrates it to some moderate depth and is absorbed internally, while that which is incident on land is wholly absorbed superficially, or within a very minute thickness. Water, moreover, is eminently a non-conductor of heat, so that once received into its substance, it is only diffusible by agitation; and since this, however violent at the surface of the ocean, diminishes rapidly with the depth, the ultimate communication of heat downwards to any considerable depth is a very slow process. By far the greater portion of the

daily supply of heat to water, then, may be said to float within a moderate depth of the surface, forming a kind of reservoir of heat. On the other hand, water is a *good radiant*, and as such is continually, both day and night, giving off radiant caloric, which is absorbed by traversing the air, and thereby tends to raise the temperature of the latter medium. Hence, it is most probable that much of the heat so radiated off is detained in the lower strata of air. Meanwhile a balance is struck in the water itself of the quantities received and parted with, by the preponderance of one or the other of which it gains or loses in average temperature in the twenty-four hours. Thus, in the warm season, when days are long and nights short, the general temperature of the air is slowly rising above its annual average, and *vice versa* in the opposite season. Below a certain depth, however, the temperature of the ocean would appear to be determined by other causes, and to be very little dependent on its superficial amount or fluctuations. It results from the observations of Kotzebue, Beechy, and Sir James C. Ross as a general fact ascertained by thermometric soundings that the deep-sea water below a certain level, determined by the latitude, is of invariable temperature throughout the globe, and that a very low one; the calculations of Lenz founded on Kotzebue, results, giving 36° F., and those of Ross, $39^{\circ}.5$ (which last is the temperature at which pure water attains its maximum of density). The depth at which the fixed temperature is attained, is about 7,200 feet at the equator, diminishing to latitude 56° on either side of that line, where it attains the surface, and the sea (superficial currents apart) is of equal temperature at all depths. Thence, again, the upper surface of this uniform substratum descends, and at 70° of latitude has already attained a depth of 4,500 feet. Thus the ocean is divided into three great regions; two polar basins in which the surface temperature is below 39° , and one medial zone above it, attaining 82° at the equator, and at the poles of course the freezing point of sea-water. It is within these respective regions only then, that superficial currents can act as transporters of meteorological temperature.

"The habitudes of dry land with relation to incident heat are very different. There is no mobility of parts, and the communication of heat downwards is therefore entirely a process of conduction. But what is most influential, is the fact that the absorption is performed strictly on the exposed surface, which therefore in the instant of absorption fixes upon itself within a very minute depth all the heat which, falling upon water, would in the same instant be disseminated through many feet or yards of its substance. The mere superficial film then becomes much more heated, and since it is a law of radiation that its intensity increases rapidly with the temperature of the radiant surface, it radiates out on the very instant a much larger fraction of the total incident heat, than in the case of water, besides imparting to the air, by contact communication a proportionally greater amount. In water, the absorbed heat is for the most part withdrawn from the radiant action, enveloped and husbanded. In dry land it is instantly and wholly exposed to such action in its most intense form. It is no uncommon thing in dry and light (*i. e.* badly conducting) soils, in hot climates to find a superficial temperature of 120° to 140° F., or even more.

"That portion of the heat which enters the soil is conducted downwards, and so long as the surface is gaining in temperature a wave of heat is continuously propagated downwards into the earth. When the surface, however, by the decline of the sun, begins to lose heat, this ceases, and (the radiation still continuing) what may be called a wave of cold (less comparative heat) begins to be propagated, and so on alternately during the day and night. These waves as they run on spread forwards and backwards, and so by degrees neutralize and destroy each other. Thus the diurnal fluctuations of temperature beneath the surface grow continually less as the depth increases, the rate of diminution depending on the "conductibility" of the soil. In ordinary soils, the difference between the diurnal and nocturnal extremes becomes imperceptible at four feet below the surface. In like manner the general increase of heat due to the summer season, and of cold during winter are propagated in similar, but larger and fuller annual waves, which, in their turn neutralize each other at more considerable depths and become imperceptible at forty or fifty feet. Prof. Forbes has shown in an elaborate memoir on this subject that at depths varying from fifty-seven to ninety-nine feet according to the nature of the soil, the annual variation does not exceed $0^{\circ}.01$ C.

"The absorption of incident heat as *solar heat* and its radiation outwards as terrestrial heat (*i. e.* heat of a much more absorbable nature) by the solid surface depends very much on the nature of its substance; but if the ground be covered with vegetation, the whole of the incident heat is returned back either by radiation or contact communication, to the air; and the soil receives no heat where so covered otherwise than circuitously through the medium of heated air. All these causes acting together, produce a vast difference as respects the temperature of the air in regions of the globe covered by the ocean and those occupied by dry land. In the former, the fluctuations both diurnal and annual are confined within very much narrower limits than in the latter; and this contrast which theory indicates, is confirmed by universal observation as the expression of the distinction between an *insular* and a *continental* climate, or that of a small island remote from all other land and of the central regions of an extensive continent. If there be one general feature in meteorology more prominent than another it is the uniformity of temperature over large bodies of water, as compared to that under similar exposures to the sun on land."

Terrestrial Radiation.

"The theory of radiant heat promulgated by Prevost, which all experimental enquiry into the subject, has tended to confirm, lays it down as a principle, that a mutual interchange of heat is continually taking place between all bodies freely exposed to view of each other, the hotter radiating more than the colder, in the ratio of some function increasing with the temperature. The experiments of Dulong and Pefit on the radiation of bodies in vacuo have shown that this function, within the limits of their experiments is of the exponential form, or in other words, that the force of radiation in vacuo increases in geometrical progression as the excess of temperature of the radiant body above that of its envelope increases in arithmetical. Hence when a hot body is placed in presence of bodies, some colder, some hotter than itself, an equilibrium will rapidly be established, in which its momentary gains and losses of heat to and fro among them all will balance each other, and its temperature will thenceforward be unchanged.

"The mean temperature of the earth remaining unchanged, it necessarily follows that it emits by radiation *from* and *through* the surface of its atmosphere, on an average, the exact amount of heat it receives from the sun; *i. e.* as much as would melt 0.01093 inch thickness of ice per minute over one of its great circles, which is equivalent to 1-40th inch of water per hour over its whole surface, condensed from its dewpoint. Taking this as the measure of the total average radiation, one-third of it, or 1-120th inch, may be taken as radiated off from the atmosphere without even reaching the earth, and the remaining two-thirds, (1-60th inch), may be considered as got rid of by radiation from the surface of the earth. Let us now consider the manner in which this takes place, supposing a clear sky to prevail:—

"Conduction through the soil is a very slow process, radiation a very rapid one. So soon, then, as the sun has sunk so low as not to counteract the earth's radiation, the immediate surface begins to part with its heat, at first slowly, but as night advances more rapidly, and at length faster than it can percolate from the interior to supply the waste. The surface therefore becomes greatly chilled, and a wave of cold is propagated downwards, neutralizing and destroying the heat wave rising to meet it, a process which goes on leisurely, and takes its own time. Meanwhile the chilled surface now borrows heat from the air also, to supply its waste; 1st, by contact communication; 2nd, by downward radiation; and 3rd, by condensation of vapour when the temperature of the surface air is reduced to the dewpoint, and thus attains that state of equilibrium which the circumstances admit of."

We will now consider the facts adduced by Dr. Bryce, premising that although correctly expressing the author's views as to facts and figures, it is (as is too often the case with newspaper reports), not nearly as well worded, and not as connected as the original paper. The only full copy, however, unfortunately wandered into that Slough of Despond

the Ottawa Dead Letter Office, and from that bourn few travellers return. I therefore give it as it appeared in the newspaper:—

FOREST AND RAINFALL.

The following abridgment of the paper on this subject, read by Mr. P. H. Bryce, M.A., of the Ontario School of Agriculture, before the Canadian Institute, will be found interesting:—

“That there is an estimate relation between forests and rainfall, and that the destruction of forests produces aridity and finally sterility, seems to have been long understood, the Greeks recognizing the truth of it by considering it unpardonable to cut down the olive trees in an enemy's country. The opinion of Bernard Palissey and the prediction of Mirabeau, as regarded the destruction of forests in France were sustained, and in other countries the voice of warning has been heard against this evil.

“The remark of Governor Hant, of Denver, Colorado, “I am convinced that farming in Colorado resolves itself into a question of water, and its judicious application,” the reader held to be largely true concerning various branches of farming in Ontario. In Canada, however, it was more a question of regulating the supply, or of obtaining it at the proper periods. That the Canadian climate has undergone great changes in the last forty years is looked upon largely as an inexplicable fact, while the scientist regards it as an effect dependent on physical causes known or hidden.

“The whole area of Ontario is 121,260 square miles, while that of the lakes about it is 100,000 square miles; a large portion of the Province must, therefore, be affected by this large body of water. In the autumn, when the earth's position causes a declination of the sun's rays, the surface of the treeless land becomes very rapidly cooled by radiation, and with this cooling vegetable growth largely ceases. The lake waters, however, which during the summer have been slowly storing up heat, do not radiate it thus rapidly, while experiment shows that in September the temperature of the water, at least in Lake Ontario, is higher than that of the land. In November, 1837, the water according to Professor Dewey, averaged forty-six and the land thirty-six degrees. The land begins to feel the influence of the growing sun by January, when the water has radiated most of its heat. During the whole of this period, however, the land has had sweeping over it, currents of air with their temperature elevated by contact with the warmer surface of the waters in the regions lying to the north and north-west. These, carrying moisture, come in contact with the cold land, and mists and rains are precipitated.

“Not only does the cold land cause precipitation of this moisture, but the much higher level of much of the land over that of the lakes increases the cold at about the rate of one degree for every 430 feet, and, therefore, increases precipitation. Add to these causes the influence of the north-east winds, cooled by passing over great extents of land surface, and some idea is had of the principal causes which conduce to the great snow falls of the central plateaux of this Province, while the lower and more southern countries obtain the same amounts of moisture largely as rain. Another set of phenomena mark the progress of spring, the advent of which is marked by the great prevalence of northerly winds, of which, on the whole, we seem to have more now than thirty years ago. The reasons for these northerly winds seems evident. By the 20th of March the sun's rays are beating powerfully upon the earth for twelve hours per diem, rapidly elevating its temperature. The atmosphere over the land, becoming heated, rises, and its place is supplied by cold winds coming in from the lakes, especially from the ice-cold waters and ice-fields of Georgian Bay and Lake Huron. Conditions the opposite of those of winter now exist. Instead of the moisture of the winds from the lakes becoming condensed as the winds blow over the land, the wind becomes drier, because warmer, and only when a cold north-east current meets these moist currents from the lakes will the moisture be precipitated. In the summer months we find long days, and also the perpendicular rays of the sun, elevating to an enormous extent the temperature of the treeless surface, while from the surrounding lakes currents of cooler air are continually rushing in to supply the place of the ascending heated column. These cooler lake breezes, while keeping our climate more

pleasant and moist than inland regions less favourably situated, are at the same time elevated in temperature by passing over the heated land, thus being enabled to retain the moisture which, passing over a cooler surface, they would precipitate. This condition of the air continuing throughout the whole summer season, the natural consequence would be that the summer would be drier than where the surface is protected by trees. With a bare, treeless surface, therefore, there would be:—1. An autumn warm and moist. 2. A winter with much snow, falling irregularly and much cold wind from the north and north-west. 3. A spring raw and cold, with prevailing north-west winds, with necessarily a large precipitation of moisture. 4. A hot and comparatively dry summer.

“Interposing among these phenomena the influence of trees, the relative rate of cooling between the water and the land greatly changes. With the sun’s rays beating down on the ground it will frequently rise to ninety or ninety-five degrees; but a tree intercepting the sun’s rays prevents the high temperature of the ground. Now, though the intercepting tree does become elevated, the rise is slower and never reaches the same height as that of the bare soil for several reasons:—1. The green foliage is not so good an absorbent of heat as, say a dark soil. 2. Since the tissues of the trees are full of sap, and since the specific heat of water is about four times as great as that of the soil, the sap will not rise in temperature so rapidly as would the soil. 3. On account of the circulation of the sap, successive portions are being continually presented to the heating influences of the sun’s rays, but as the rapidity of circulation is increased with heat, and as the sap, coming up from the deep portions of the earth surrounding the roots, must have a comparatively low temperature, the elevation in temperature of the whole volume of sap must necessarily be slow. 4. The much greater amount of evaporation taking place from the leaves and branches of the tree than does from the soil, produces a greater degree of cold than would be produced by less evaporation. 5. The greater amounts of moisture in the air surrounding trees will prevent a rapid rise in temperature. These causes combined prevent the tree from attaining to the maximum temperature till evening. Radiation from its surface then setting in will be much slower than in the case of the soil. Hence the temperature does not sink so low as that of the unprotected soil.

“He proceeded to explain the effect over a whole country clothed with forests, contending that while the slower decrease of the trees temperature in autumn augured a higher temperature, the moderating influences of forests on the winter were beyond question. In spring, the sun’s rays being intercepted cannot melt the snow so rapidly, and on this account spring floods are largely prevented, the winter grains and clover are protected for a longer period from the effects of thaws by day and frosts by night. Slower radiation prevents so many night thaws, and the baneful chilling influences of cold raw winds are much mitigated. Among other things, the trees, becoming elevated in temperature but slowly, act as condensers to the vapours swept over them from the surface of the lakes, thus supplying frequent showers to the growing plants, while at the same time, by preventing so rapid evaporation, they aid the rains in effecting their fructifying influences.

“The reader then proceeded to consider at length Canada’s present condition, and in doing so remarked that where settlement has existed for at least twenty-five years, three-quarters of the forest has been destroyed, while in few cases is the preserved wood distributed over the surface with any regard to its protecting influences, so it may be said, that three-fourths of the influences that would be exerted in our climate under a treeless surface are at work. 1. A cold, raw spring, with high winds and frequently much dry weather during germination. 2. A hot summer, with but little rain, the dryness increasing regularly from May to August. 3. An irregular winter, with frequent high winds, irregular snow falls, etc. These conclusions would be borne out by the following statistics:—

The total precipitation of moisture has decreased. Thus the

TOTAL SNOW AND RAIN.

1840-44	216.57 inches.
1850-54	164.684 "
1860-64	160.387 "
1870-74	152.62 "

or, between the 1st and 4th periods there was a total decrease of 63.95 inches, or a yearly difference of 12.79 inches.

The total moisture is divided as follows :—

TOTAL RAIN FALL.

1840-44.....	191.020 inches.
1850-54.....	137.999 "
1860-64.....	131.706 "
1870-74.....	113.150 "

or, between the 1st and 4th periods there was a total decrease of 77.87 inches, or a yearly difference of 15.35 inches.

TOTAL SNOW FALL (12 inches snow, 1 inch rain).

1840-44.....	322.70 inches.
1850-54.....	320.10 "
1860-64.....	344.38 "
1870-74.....	473.83 "

or, between the 1st and 4th periods there was a total difference of 151.13 inches, or a yearly increase of 12.59 inches.

These calculations agree exactly with theory. In comparing the individual quarters of each period, he arrived at the following results :—March has remained much the same still ; with April is found a decrease of more than $\frac{1}{2}$ inch, a decrease that increases with each month until September. Thus :—

	April, May, June.	July, August, September.
1840-44.....	48.55	68.101
1850-54.....	40.195	48.625
1860-64.....	32.742	45.617
1870-74.....	34.670	35.14

The significance of this unpleasant change must be evident to all. The average temperature of the two months of germination is lower now than it was forty years ago. Thus :—

	March.	April.	May.
1840-44.....	29.88	42.62	51.22
1850-54.....	30.24	40.06	50.68
1860-64.....	29.02	40.80	52.86
1870-74.....	27.24	40.18	53.36

This undoubted fact causes what is termed a late spring, the period for growth and development of the plant being shorter than formerly. The temperature of May, the first month of real growth, is now warmer than formerly, by an average of nearly two degrees. The growth is thus apparently forced unnaturally to make up for loss in April, but the attempt is rendered futile by an undue dryness, the rainfall in May having been :—

1840-44.....	15.015 inches.
1850-54.....	13.675 "
1860-64.....	14.055 "
1870-74.....	8.640 "

"The dryness increasing, the growing plant has neither the means nor the time for its perfect development, while the dryness of the last months of summer has become so extreme as to cause entire uncertainty as to the existence of good pastures. The young clover is frequently "burnt up," and general failure results.

"Mr. Bryce discussed at considerable length the causes of the wholesale destruction of our forests; the action of our Indian and Australian Governments regarding forests; the extent and condition of forests in Britain, Germany, France, Austria, Hungary, and the means adopted for preservation there.

"The remedies he suggested were reconstruction of at least part of what had been destroyed, and replanting in an intelligent manner. Another remedy was irrigation. He argued to show that cultured woodland is the most profitable form in which land can be held, and quoted the produce of an acre in seventy years to have been £469. 15s. 6d. Such facts he adduced to combat the idea of non-practicability of any organized system of tree-planting as a source of profit. The remainder of the paper was devoted to suggestions for legislation on the subject."

THE LESSONS OF HISTORY AND SOME CONTEMPORARY EVIDENCE.

We have now studied the scientific aspect, let us have a word on the results historically and geographically noticed, where forests were destroyed.

The progress made by Germany in tree-planting is but part of her general progress. The credit is given to the great Frederick; it was part of the National policy of his day, which raised Prussia from a small power to a great one, and to the energetic continuance of that policy, Germany owes Sadowa and Sedan. By this forethought vast armies have been maintained where once the sandy deserts would not nourish a flock of goats, and successive regiments of hardy soldiers have poured forth from the fertile soil where, two hundred years ago, the rugged debris of winter torrents, the thorn and the thistle, overspread a thirsty and an impoverished land.

In France, the aristocrats, not unwise in all, had preserved the forests. But when Jacques Bonhomme, not wise in all, had overthrown their tyranny, he bethought him that no good policy could flow from so bitter a fountain, proceeded straightway to emulate with the axe the ravages of the guillotine, and succeeded in no long time in almost staying crop growth in field or meadow adjacent to where he had heaviest laid his grove-destroying hand. Wiser councils now prevail; experience has borne its fruits, and the French forests, particularly those near the sea, bear witness how readily Providence assists a liberal, how sternly she repays a greedy and a grasping cultivator. There is a deep lesson in the old verse, "Thou shalt not reap the corners of thy field."

It may be said of a large part of Italy, of Spain, and of Turkey, that, owing to the injudicious clearing of the forests from their most elevated portions—the watersheds, in fact, which fed the nether springs, bubbling spontaneous up, the source and feeders of many a river through all the lower land—fully one-third of those countries are in a state of infertility and insalubrity as unnecessary as it is complete. The tourist of to-day, full of Cervantes and of Le Sage, passes through Spain in wonder whither have gone the umbrageous forests, the pleasant groves, the cool fountains which, however few their other comforts, never failed to the philosophic Gil or the chivalrous Don. In Turkey, too, he can well see why the crescent pales, when he observes vast pachaliks, once sending many thousand strong sons of Islam to the horse-tail standards, now desert and barren, despoiled of their forests, and necessarily, thereafter, stripped by the elements of the soil

those woods alone preserved. It is not the mere absence of men. Turkey has many subject territories, and many means of retaining recruits. It is that there has been an absence of thinkers—of leaders—of men who had minds to understand the sources of fertility and national strength, and energy to impress them on their countrymen. When we read of the great armaments sent out, in former days, by the Ottomans, by Spain, by Greece, we should remember that these great efforts—now represented by a rusty anchor, some broken armour on the hall pillars, or a few time-shattered towers, and perhaps three lines in a history—augured and indeed implied broad harvests, industriously worked mines, industries of many cities, vast store of cattle and of horses, and all that goes to fill the cup of national strength. Now, long deserted shores, deserts where once the well-kept fences for a hundred leagues carefully divided the rich land among its proud proprietors; grass-grown mounds where rose the myriad sounds, where flourished the countless industries of great cities, meet the traveller's eye. Why? They destroyed the protecting forests; the land parched into sterility; the strength of the possessors faded in a few generations away.

Throughout the North American continent, where winter's frost and summer's heat, with fervid alternations elsewhere unknown, try the temper of the soil, there is every reason to believe that the process of destruction, once the forests are withdrawn, will be more rapid and more thorough than in other lands. This has already, in Wisconsin, Minnesota, New York, Kentucky, and nearly all the settled states, been a source of deep uneasiness to reflective minds. The north-western waters, it is said, have now lost half their draught-power, and the whole wide-draining tributaries of the great Mississippi are losing their steady depth, while in spring and fall, those terrible inundations we have lately seen carry off the waters—then as injurious as they might have been beneficial. An Ohio man, at the Cincinnati convention said, "Let the hills be deprived of the rest of the protection which the forests afford, and half of the area of the State will be sterile in less than fifty years. The rain will wash the soil from the hill-tops first, then from the slopes; the limestone, which is now covered with productive humus, loam and clay, will be laid bare; the naked rocks will reflect the rays of the sun and increase the summer heat, the north storms will blow unhindered over the country, and every change of the wind will cause an abrupt change in the temperature. The rainfall will be diminished and become irregular. Snow and rainwater will at once run down in the valleys and cause periodical freshets, which will ultimately carry away the best part of the soil, even from the valleys. Such will be the unavoidable results of further devastation of the timber." Mr. Clay, of Kentucky, remarked at the same gathering: "I move in the sphere of experience with more certainty. I remember when the forests were hardly broken here that springs of water were very frequent and perennial. The rivulets and creeks and rivers had a perpetual flow; these have now changed. The rivulets and creeks are now dried up in summer, and the fish so often caught by me in earlier years are now gone. Not one spring in a thousand remains." I would beg my readers to note what follows particularly; it is also my own experience here. Mr. Clay goes on:—"Indian corn was generally planted in March, and the rains and exhalations of moisture from the surroundings made crops successful every year. Now, the destruction of the forest has lost to us that bed of leaves which was a perpetual reservoir of water for springs and for

evaporation ; aided by the treading of the hard surface, the rainfall, if the same as of old, rushes off at once, sweeping the soil into the Mississippi delta. The dry winds absorb not only the ancient humidity of the air, but drink up the subsoil evaporation. So that our winters are longer, more changeable, and unendurable. Corn can hardly be planted safely till late in April, and drought too often ruins our best efforts. Now, trees do influence rainfall in a State like Kentucky, where the rain is not precipitated by mountain heights, but by the meeting of warm, moist, and cold winds. Here one neighbour has plenty of rain, another scarcely any. And even if the rainfall should be the same for the whole State, the owners of forests have reason to believe that these windbreaks are favourable to rain eddies and rain-bearing currents of air." Prof. Sargent, of Harvard University, who has given perhaps as much study to this question as any one in America, remarked that, "As moderators of the extremes of heat and cold, the benefits derived from extensive forests are undoubted, and that our climate is gradually changing through their destruction, is apparent to the most casual observer. Our springs are later, our summers are drier, and every year becoming more so ; our autumns are carried forward into winter, while our winter climate is subject to far greater changes of temperature than formerly. The total average of snowfall is perhaps as late as ever, but it is certainly less regular, and covers the ground for a shorter period than formerly. Twenty years ago peaches were a profitable crop in Massachusetts ; now we must depend on New Jersey and Delaware, and our apples now come from beyond the limits of New England. The failure of these and other crops in the older States is generally ascribed to the exhaustion of the soil, but with greater reason it can be referred to the destruction of the forests which sheltered us from the cold winds of the north and west, and which, keeping the soil under their shade, cool in summer and warm in winter, acted at once as material barriers, and reservoirs of moisture."

STATEMENTS COLLATED FROM THE WORKS OF DISTINGUISHED WRITERS ON THE SUBJECT.

We have now gone over the influences which connect the presence of forests with the climate of a country, first considered in a general, and then in a local sense. I will now, by way of corroborative proof, quote a number of passages from those authors who have made this question their special study. In Europe, where, within the last ten or twelve years especially the subject is creating very great interest, from the evident decrease in moisture and corresponding fertility, much is being done to examine into the evil and remove its causes. One of the first to move in the matter was a distinguished European gentleman of both theoretical and practical experience. Herr Gustav Wex, Counsellor of State and Director-in-Chief of Works undertaken for the regulation and flow of the Danube. He says:—

"Having in foregoing statements given indisputable evidence that in the five principal rivers of Central Europe,—the Danube, the Rhine, the Elbe, the Vistula and the Oder, the basins of which embrace an area of 26,860 (German) square miles,—the lowest and the mean annual water levels, and consequently also the quantities of water delivered by these rivers, during a lengthened period of many years, has been continually decreasing, we may from this draw the following conclusions:—

"1. As the aforesaid rivers are fed mainly by the brooks and streams which flow into them, there must have been also in these a continued decrease in the quantity of water delivered by them for a great many years, from which we may further conclude that if observations had been made on the levels of the different feeders, similar to those which have been made on the five large rivers named, and these had been compared, they would have supplied results similar to those at which we have arrived concerning these.

"The correctness of this allegation receives confirmation from the fact that many manufactories, etc., which have been built during the last fifty years, on rivulets and streams, have experienced a marked diminution in the quantity of water coming through their water-leavings, and it has been found necessary to employ steam-engines to meet the deficiency of their water-power, which was originally sufficient for the work they had to do.

"2. As it is possible that the causes which have produced the effect of the lowering of the water level, and diminution of the quantity of water delivered in these five river basins, operate equally in the basins of the other rivers and streams in Europe, and not only so but in the most populous and cultivated districts of the other three quarters of the globe—it may be assumed that in most of the streams and rivers on the surface of the earth, a similar lowering in the lowest and mean levels of the body of water delivered by them has taken place; while the high floods in the same, reaching a higher point, and becoming of more frequency, discharge a greater quantity of water, and produce more extensive devastating inundations than previously was the case.

"3. If the causes which have operated in producing the decrease in the usual water flow of the streams and rivers, with the rapid overflowing of them in times of flood, in the course of the last 140 years, were to continue to operate also in the future, it is evident from what has taken place that in brooks, and streams, and rivers, the lowest and the mean level of these may be expected to be lowered still further in the future. And the question forces itself upon every one involuntarily to what degree may this diminution in the quantity of water thus delivered by the several streams and rivers be carried?

"A consideration of the three rivers—Weser, Elbe, and Oder—makes clearly manifest a reduction in the quantity of water delivered by them, and a silting up of the river-bed with sand. It has been calculated that if the Elbe continue to diminish in the future at the same rate at which it has been diminishing up to this time, it will soon be impossible for heavily laden ships to pass by it. Nor is it otherwise with the Oder; in the very dry year 1858, there were only *eleven* days in which the navigation of the Oder in Silesia could be carried on with full force. The Weser delivers the smallest body of water of the three. One principal reason for this is the destruction of forests which has taken place on the heights which are found alongside of the river, and which the Government have latterly taken steps to prevent; but still more than what has resulted from the destruction of forests has been the consequence of the rectifications of the river-bed, which it has become a general practice to carry out.

"After weighing fully the collected observations on the water level, and consequences deduced from them in the foregoing treatise, I think no Hydrotechnik will venture to call in question the correctness of the allegations advanced by the distinguished hydrographer Dr. Berghaus, in the year 1835, which allegations have been confirmed and established by myself, that in the brooks, streams, and rivers in Central Europe, within the period of observations, extending over about 140 years, high floods now appear and attain a greater height; on the contrary, the lowest, and the *mean* levels of the rivers are falling, and consequently the delivery of the water by these streams and rivers is being continuously diminished to a very great degree."

There follows an expression of the views of the author on the great practical importance of the fact brought to light. In the second chapter he describes the reduction observed in the flow of springs and in the quantity of water yielded by them, and after citing numerous facts, illustrative of these points, he thus concludes:—

"In regard to the diminishing of subterranean waters, we can adduce the following evidence:—

"As we have in the preceding chapter shown, from observations on the water level continued through long series of years, that there has been seen in later decades a lowering of the level of the lowest and of the *mean* annual flows, while the high floods consequent on storms of rain, have become of more frequent occurrence—from which it comes to pass that a greater quantity of water is thus carried away at such times than formerly—it follows as a consequence that if the quantity of the rainfall remains the same, the proportion of this flowing away on the surface of the earth in such circumstances has increased. On the other hand the proportion sinking below the surface must be less; and from this it comes to pass that the quantity of the subterranean water supply, the drainage and superficial waters, and with them the springs which are fed by them must have been reduced; and the correctness of this conclusion can be established by the following facts:—

"From these long continued observations on river levels we have further proved that on brooks, streams, and rivers, in these later times, the lowest and *mean* levels, and also the quantity of water delivered, have been being continuously reduced, and that to a marked degree; and that in the very months during which the water courses have been fed almost exclusively from subterranean flows of water and from springs the diminution of the water delivered has been greatest. Whence it may with all justice be concluded that in these later times the water supplies in subterranean reservoirs and the water bearing strata have decreased, and also that drainage waters and the springs in a river basin in their collective contributions now furnish smaller water supplies to the feeding of the river course than was the case at an earlier period."

Herr Wex goes on to say:—"I consider that I have satisfactorily proved, by the foregoing observations, deductions, and examples, that in recent times the supply of water in subterranean reservoirs, and in the water-bearing strata of the earth, is being diminished; further, that many of the drains and springs of to-day have become some quite dry, and others yield a comparatively small supply of water; and finally, that through these changes the lowest and the *mean* water-levels in brooks, streams, and rivers are being continuously lowered, and the quantities of water delivered by them continuously diminished.

"If this continuous diminution, which has been going on for the last 140 years, is to go on continuously still, then will these results and changes on the surface of the earth entail on coming generations evils, and evils of incalculable extent and magnitude. Through the lowering of the level, and reduction of the rivers and of the subterranean drainage, and also through the alternation of very wet and very dry years,—such as is shown by the diagram referred to, to be prevailing,—will the fertility and productiveness of the land be reduced in no inconsiderable degree, and not a few lands now covered with luxuriant vegetation will become veritable deserts, cheerless and desolate.

"After the drying up of many brooks and streams, and after the conversion of streams and rivers into torrents, in consequence of these changes, men would have to go for their water supplies for drinking and for domestic use, and for other purposes, either to the deeper-lying water-bearing strata of the earth, or to a greater distance from their dwelling; whereby the cost of the water consumed would be increased, while many industrial establishments and manufactories would be deprived altogether of the supply of water indispensably necessary to their operations, and would have either to adopt expensive means of providing a substitute for what has been lost, or remove to some remote district where brooks and rivers have not as yet been deprived of their water supplies.

"Finally, by the continuous diminution of water in streams and rivers, the former would become quite dry through the greater part of the year, and the latter would become unnavigable.

"As, through the consideration of what has been advanced, it may thus be seen that, through the continuous diminution and lowering of the flowing water on the surface of the earth, there is imperilled—and that to a great extent—not only the prosperity and the health, but also the existence of future generations, it is desirable that numerous

students of physical science should be incited to further research into the cause of these intimately connected phenomena, and then to devise measures to avert the impending calamity, in so far as it may be within the scope of man's power to do so."

The author adds :—"I have given myself also to an attempt to a solution of this difficult problem, and I give the results of my researches in this study in the two following chapters, in the hope that distinguished *collaborateurs* in the same calling, and men of scientific attainments may prosecute further the researches I have been privileged to commence, and that the results of their study may bring great good to the generations yet unborn.

The chapter which follows is occupied with a discussion of the cause or occasion of a diminution having taken place in the quantity of water flowing in streams and rivers, which he thus concludes :—

"When we fully realise what is implied in the opinions expressed by men of science, and practical men expert in such matters, in various countries, and in very different parts of the world, after long experience, observation and research, we find that forests effect to a very great extent the quantities of water coming from springs and flowing in rivers ; that they affect the climate ; and that they have a good effect upon the fertility of the lands in which they exist ; and that thus :—

"1. The deposit of rain from the atmosphere is greatly increased by the amount of woods in a district, inasmuch as mists and clouds passing along the surface, striking upon the forests, have the moisture of which they are formed condensed and precipitated as rain. Further the temperature within the woods is cooler by day, and, on the contrary, warmer by night than it is in the open fields and meadows ; and by reason of this, there is a continual circulation of air in the vicinity of forests whereby mists and clouds are precipitated and led to discharge themselves of their contents. This happens not through the forests in and for themselves, nor as a consequence of the forests of themselves, but through the difference between the forests and the open fields ; and on this depends the abundance of the rain. It is also very manifest that the forests exercise an attractive influence upon the clouds, by their attracting from them electricity with which they are charged, and with this the water of which they are composed, increasing thereby the rainfall. It is also an ascertained fact that a great part of the water precipitated as rain remains on the leaves of the trees, one part of which falls to the ground, but another portion of which evaporates into the atmosphere, and is again precipitated as fog, mist, dew, or rain,—whence it comes to pass that rain water is kept longer within forest lands, and may be precipitated oftener than once, whereby the rainfall is increased.

"2. Through the abundance of forests will the copiousness of the subterranean drainage flow, and springs be increased, while the rainwater retained by the foliage of the forest trees, falling slowly to the earth, is kept by the spongy character of the ground in woods, from flowing quickly away, and is in part absorbed, or is left to permeate the mineral strata, which is considerably facilitated by the numerous spreading roots of the trees penetrating cracks, fissures, and canals in the superficial ground, by which means the rainwater reaches a greater depth, and this in a much greater quantity in forest ground than in the open field. Further, by numerous experiments, it has been established that the evaporation of the humidity in the open country is at least from four or five times as great as it is in woodlands ; from all which it appears that the moisture absorbed in forests is not so readily evaporated, but it is retained and directed to the feeding of drainages, springs, and brooklets.

"3. If forests be uprooted, more especially in mountainous regions, or even in somewhat hilly country, the raindrops, falling upon the exposed ground with some force, tear it up, and then, flowing down the declivity with considerable rapidity carry with them earth and stones towards the brooks, and streams, and rivers, by which these water courses are suddenly filled up, and experience much higher and more devastating overflow-

ings and inundations, than was the case while the woods stood, as is explicitly testified by the aforementioned tabulated observations of river levels.

"4. Through the extensive clearing away of forests the heat of the summer months and the desiccation of the ground becomes increased, then, as a consequence of this, the duration of droughts is prolonged, and from this there follows naturally a diminished productiveness of the land.

"These most disastrous effects of the clearing away of forest show themselves in a very marked degree in these countries, once blessed with a luxuriant vegetation, Palestine, Persia, Greece, Sicily, Spain, and the Canary Islands."

Mr. Marsh in his treatise on "The Earth as Modified by Human Action," in writing of the influence of forests on the flow of springs, says:—"It is an almost universal and, I believe, well-founded opinion, that the protection afforded by the forest against the escape of moisture from its soil by superficial flow and evaporation insures the permanence and regularity of natural springs, not only within the limits of the woods, but at some distance beyond its borders, and thus contributes to the supply of an element essential to both animal and vegetable life. As the forests are destroyed, the springs which flowed from the woods, and, consequently, the greater water-courses fed by them, diminish both in number and volume. This fact is so familiar in the American States and the British Provinces, that there are few old residents of the interior of those districts who are not able to testify to its truth as a matter of personal observation. My own recollection suggests to me many instances of this sort, and I remember one case where a small mountain spring, which disappeared soon after the clearing of the ground where it rose, was recovered about twenty years ago, by simply allowing the bushes and young trees to grow up on a rocky knoll, not more than half an acre in extent, immediately above the spring. The ground was hardly shaded before the water reappeared, and it has ever since continued to flow without interruption. The hills in the Atlantic States formerly abounded in springs and brooks, but in many parts of these States which were cleared a generation or two ago, the hill-pastures now suffer severely from drought, and in dry seasons furnish to cattle neither grass nor water."

EFFECTS OF FORESTS AND OF THE DESTRUCTION OF THESE ON RIVERS, AND STREAMS, AND SPRINGS, BY JOHN CROUMBIE BROWN, LL.D.

"It is a somewhat prevalent opinion that as rain proceeds from the clouds, rivers have their primary source in springs; and along with this opinion it is held by many, that the primary function of rivers is to carry moisture to lands which otherwise would be barren, and there to diffuse fertility. But, in point of fact, no water springs from the ground which has not previously been deposited from the atmosphere; and the primary function of streams, brooklets, and rivers, is simply to carry off surplus moisture in excess of what the soil can retain.

"As rain is produced by the gravitation to the earth of surplus moisture in the atmosphere in excess of what the air can contain suspended in a state of invisible vapour at the temperature to which it has been reduced, rivers are produced by the gravitation to a lower level of the surplus water so precipitated in excess of what is absorbed by the earth or evaporated again into the atmosphere.

"The popular phraseology in regard to many things is far from being in exact accordance with scientific conceptions. We speak of catching cold, of the rising sun, and of the new moon. And so we speak of the little spring of water at the greatest distance on the highest elevation from the mouth of a river as its source; but no one supposes that the whole of the waters of the river come from this. It may be that there is not an inch of its course, or of the courses of its numerous tributaries and affluents, which does not pass many of its sources, channels of capillary dimensions, through which, from time to time, such excess of rainfall has drained off, or may drain off, into its bed, by which the accumulated drainings are drained off into the sea, if they be not absorbed or evaporated by the way.

"It is under this aspect of springs, and streamlets, and rivers, we should look at them while considering the local effect upon them of forests, or of the destruction of these."

Mr. Marsh says:—"With the extirpation of the forest, all is changed. At one season the earth parts with its warmth by radiation to an open sky; receives, at another, an immoderate heat from the unobstructed rays of the sun. Hence the climate becomes excessive, and the soil is alternately parched by the fervours of summer, and seared by the rigours of winter. Bleak winds sweep unresisted over its surface, drift away the snow that sheltered it from the frost, and dry up its scanty moisture. The precipitation becomes as irregular as the temperature; the melting snows and varied rains, no longer absorbed by a loose and bibular vegetable mould, rush over the frozen surface, and pour down the valleys seawards, instead of filling a retentive bed of absorbent earth, and storing up a supply of moisture to feed perennial springs. The soil is bared of its covering of leaves, broken and loosened by the plough, deprived of the fibrous rootlets which held it together, dried and pulverized by sun and wind, and at last exhausted by new combinations. The face of the earth is no longer a sponge, but a dry heap; and the floods which the waters of the sky poured over it hurry swiftly along its slopes, carrying in suspension vast quantities of earthy particles, which increase the abrading power and mechanical force of the current, and augmented by the sand and gravel of falling banks, fill the beds of the streams, divert them into new channels, and obstruct their outlets. The rivulets, wanting their former regularity of supply, and deprived of the protecting shade of the woods, are heated, evaporated, and thus reduced in their former currents, but swollen to raging torrents in autumn and spring.

"From these causes there is a constant degradation of uplands, and a consequent elevation of the beds of water-courses, and of lakes, by the deposition of the mineral and vegetable matter carried down by the waters. The channels of great rivers become unnavigable, their estuaries are choked up, and harbours which once sheltered large navies are shoaled by dangerous sand-bars.

"The earth, stript of its vegetable glebe, grows less and less productive, and, consequently, less able to protect itself by weaving a new net-work of roots to bind its particles together, a new carpeting of turf to shield it from wind, and sun, and scouring rain. Gradually, it becomes altogether barren. The washing of the soil from the mountains leaves bare ridges of sterile rock, and the rich, organic mould which covered them, now swept down into the low dank grounds, promotes a luxuriance of aquatic vegetation that breeds fever and more insidious forms of mortal disease by its decay, and thus the earth is rendered no longer fit for the habitation of man."

Mr. Marsh also states in regard to a forest:—"By its interposition, as a curtain between the sky and the ground, it both checks the evaporation from the earth, and mechanically intercepts a certain portion of the dew and lighter showers, which would otherwise moisten the surface of the soil, and restores it to the atmosphere by exhalation. While in heavier rains the large drops which fall upon the leaves and branches are broken into smaller ones, and, consequently, strike the ground with less mechanical force, or are, perhaps, even dispersed into vapour without reaching it.

"The vegetable mould, resulting from the decomposition of leaves and of wood, seems as a perpetual mulch to forest soil by carpeting the ground with a spongy covering which obstructs the evaporation from the mineral earth below, drinks up the rains and melting snows that would otherwise flow rapidly over the surface, and perhaps be conveyed to the distant sea, and then slowly give out by evaporation, infiltration, and percolation, the moisture thus imbibed. The roots, too, penetrate far below the superficial soil, conduct water along their surface to the lower depths to which they reach, and then by partially draining the superior strata, remove a certain quantity of moisture out of the reach of evaporation.

"The meteorological effects produced thus by forests resolve themselves into the prolongation and consequent increase of the evaporation of water falling in the forms of rain, snow and hail, effected in two distinct operations; first, the absorption and reten-

tion of a large portion of the rainfall, and second, the retardation of the flow of the remainder towards the great reservoir and source of all, in accordance with the observation of the Hebrew preacher, 'All the rivers run into the sea; yet the sea is not full; for unto the place from whence the rivers come thither they return again.'

There is another operation, noticed by Becquerel, to which sufficient importance has not, until very recently, been generally ascribed, namely, the mechanical action of roots as conductors of the superfluous humidity of the superficial earth to lower strata. "The roots of trees," says he, "often penetrate through subsoil almost impervious to water, and in such cases the moisture, which would otherwise remain above the subsoil, and convert the surface earth into a bog, follows the root downwards, and escapes into more porous strata, or is received by subterranean canals or reservoirs. When the forest is felled the roots perish and decay, the orifices opened by them are soon obstructed, and the water, after having saturated the vegetable earth, stagnates on the surface and transforms it into ponds and morasses. Thus, in La Brenne, a tract of 200,000 acres, resting on an impermeable subsoil of argillaceous earth, which ten centuries ago was covered with forests, interspersed with fertile and salubrious meadows, has been converted by the destruction of the woods into a vast expanse of pestilential pools and marshes. In Sologne the same cause has withdrawn from cultivation and human habitation not less than 1,100,000 acres of ground, once well-wooded, well-drained and productive."

FROM THE REPORT OF JOHN EDNIE BROWN, ESQ., CONSERVATOR OF FORESTS, TO THE
PARLIAMENT OF SOUTH AUSTRALIA:—

That large bodies of trees have a direct influence on the atmospheric changes of a district or country is, I think, in these days of so much statistical and other reliable information, now a recognized fact. If we look back and examine ancient, mediæval, and modern history, we there find many very noted examples of decrease of rains, dried up rivers, extended deserts and depleted populations, simply from the clearing of extensive forests; while again, on the other hand, it has been observed that where large tracts of country have been laid under a crop of trees, and which previous to this having been done were designated dry and comparatively unproductive parts, small streams of water have been found where none formerly existed, and the general nature of the districts has been improved to such an extent that they have become highly favourable for agricultural purposes, and hence more able to sustain an increased population."

1. "*Trees give Shelter*.:—In the agricultural parts of this colony, especially in the northern areas, where extensive tracts of most excellent country are open to every blast of wind that blows, it is self-evident that the planting of belts of trees in different directions through them would have a most beneficial influence on the crops which are produced upon the ground. The direct results of such belts would be that the hot winds, which at present are the very scourge of the country so far as their effects upon vegetation are concerned, would, if they were not in time subdued altogether, be at all events considerably softened by coming in contact with the cooler atmosphere arising from the damper surface of the ground shaded by trees, and therefore pass harmlessly over the country; and thus the crops would not only be more certain, but would grow more luxuriantly, and consequently the yield would be proportionately larger. Again, another important result which would arise to the agricultural community from the planting of trees on the plains would be, that shelter would be given to stock, both from the hot winds of summer, and the storms and cold blasts of winter."

2. "*Forests Prevent Evaporation*.:—It is, perhaps, almost superfluous to remark that very great evaporations take place all over the colony at all seasons of the year, from the thoroughly exposed character of the country generally to the full power of the sun's rays. In consequence of this, what rain falls upon the ground is, almost as soon as it reaches the ground, again taken up into the air by evaporation, without being retained in the soil for the use of the crops growing upon it. Even on those parts of the country which are under indigenous forests, from the scattered and generally sparse crop of trees constituting these, together with the peculiarly characteristic feature of the Australian trees, affording but little shade to the ground—owing to upright habit of the foliage—

evaporation goes on in a very rapid manner. It is chiefly to these causes alone that I attribute the fact of their being so few never-failing creeks and rivers in this colony. Now, were there judiciously laid out plantations all over the country, and the trees constituting these being at such distances apart, and of such kinds as would effectually shade the ground from the sun and prevent evaporation to a certain extent in these parts, or at least in a much slower manner than is done at present, the rain would have time and opportunity to be absorbed into the ground, and by percolating to considerable depths, come out again at a lower level, and thus cause streams of water where none exist at present, and so on from place to place, keeping up a general degree of humidity to refresh and encourage the growth of vegetation.

3. "*Forests have a Tendency to Equalize Rainfall* :—In this colony, the climate of which is considered very dry, nearly as much rain falls within the twelve months as there falls within the same period in some countries which are nearly humid ones. In moist climates we find that on nearly three-fourths of the days of the year, rain falls more or less. In this country, again, there are at least three-fourths of the twelve months which are entirely cloudless. And still the rainfall in both instances is not in like manner disproportionate so far as the total amounts for the year are concerned. These appear somewhat contradictory statements, but yet they are approximately correct for many cases which could be cited. The reason of the difference is not that the one country lies perhaps in the northern hemisphere, and the other in the southern, or that the one may be fifteen degrees nearer the equator than the other. No ; the grand secret is that the country which has its rainfall spread over the whole year is thickly covered with trees, while in the case of our own colony there is a very small proportion of its area occupied by forests. In two or three hours in this country as much rain will fall as would occupy two days steady drizzling in Great Britain.

4. "*Forests Attract Rainclouds* :—That this is the case is now a very well ascertained fact. I do not, however, hold myself to the opinion of some writers that *the trees themselves* abstract the rain, but rather that the *results* flowing from a large body of trees have this tendency. To put the matter in a scientific form we find (1) from the shade given by the trees the temperature of the earth is lowered ; (2) the atmosphere hovering immediately above the trees is in consequence lower than that in part of the country adjoining which may be clear of vegetation ; consequently it follows (3) that if hot clouds flow over a plantation they will be cooled down and their moisture condensed upon coming in contact with the cold, humid atmosphere hanging about the trees, and as their power of holding water in a condition of vapour is sensibly diminished in a certain ratio according to the fall of temperature, the result is a deposit on the ground of either rain, mist or dew ; and again, (4) clouds containing vapour, which have blown over dry ground heated by the sun, where the air is in consequence highly rarefied and warmer than the clouds, these dissolve themselves and vanish ; but should these clouds come in contact with the cooler air above masses of trees, they become overcharged with moisture, and rain is the result.

5. "*Forests Subdue Aridity* :—We have seen that the planting of large bodies of trees has the indirect influence of attracting rainclouds to the sites occupied by them, and that the atmosphere generally about woodlands is in a continual state of moisture by transpiration from the pores of the leaves, and by a certain amount of evaporation from the ground by the heat of the sun. From this, then, it will at once be seen that by planting arid tracts of land with properly proportioned belts of timber here and there through them, the result is (1) lower temperature ; (2) arrest of hot winds ; (3) shelter ; (4) more frequent rains ; and (5) a more humid climate generally, thus making such tracts of country suitable for agricultural purposes.

6. "*Forests make Climate more Humid* :—This is a result and contiguous part of the whole system of the different influences of trees upon climate which have already been explained. Water is sucked up from the soil by the roots of the trees, and is exhaled again in the form of vapour from the stomata on the back of the leaves ; this rises into the air and forms itself into clouds, and, if not deposited again on the ground as rain by some counter-balancing atmospheric influence, is wafted across the country, cooling the air and keeping up a supply of heavy dews which refresh and invigorate vegetable life.

While again, the humidity of the climate is maintained from the simple fact that the green, moist foliage of the trees constituting the forests has the well-known tendency of preventing the increase of the sun's rays by radiation, and thus reducing the chances of evaporation.

"The Count de Gasparin has found that soils covered with low vegetation or with woods, and in which the soil is composed of humus, mingled with sand and lime or clay, absorb more water than those which contain no humus, and consequently retain it longer than the latter. These effects vary, according to the proportions of the various elements of which the soils are composed. The infiltrations are greater in wooded lands than in those covered with sod. The roots penetrate deeper, and thus facilitate the passage of waters, which would be only stopped by an impervious stratum.

"The branches of trees in leaf not only oppose the evaporation of the water in the soil, but the leaves themselves are constantly yielding a vapour from exhalation, and which tends to reduce the evaporation of waters, so far as the moisture exhaled goes to saturate the air, the infiltration at the same time going on into the soil. Herbaceous plants, not in masses, do not produce similar effects; in fact, whoever has been in places partly wooded and partly sodded must have observed, after a rain and a rest of some duration, that the sodded grounds were dry, while the wooded soil was always damp.

"We will now speak of the water absorbed by the roots, and that which is exhaled into the atmosphere.

"The roots of trees, as shown by the experiments of Hales and others, absorb a large amount of water, charged with various elements constituting the sap. The surplus water is evaporated from the leaves, which are constantly surrounded by a humid atmosphere. The water thus evaporated is drawn, not only from the upper strata, but likewise from the deeper layers of the soil into which the roots penetrate, and which supply little or no water to herbaceous vegetation. These lower strata are fed by subterranean sheets of water that often come from a distance. Furthermore, this water remaining in these lower strata, being thus given to the atmosphere, fall again as fog, dew or rain, and thus increase the quantity of water that the surface of the soil receives from some distance away.

"The amount of water absorbed by the roots is so great that it is practically difficult to make much of it remain near the trees, several reasons for preventing it occurring. The soil in contact with the roots, and for a little distance away, is in a certain state of desiccation; little by little it loses its nutritive properties, the lime, etc., and when these elements are gone, the soil contains little but sand and clay, which then becomes permeable. It is, therefore, well demonstrated—

"(1.) That a difference exists between the evaporation from a naked soil and a soil covered with sod.

"(2.) That there is a like difference between a soil covered with sod and one that is wooded, with the further advantage of the latter in facilitating the infiltration of water.

"(3.) That the amount of water absorbed by the roots does not produce drought in the soil, since it is returned after evaporation in the condition of fog, dew or rain. The drought does not take place till the soil is exhausted."

The thermal influence of forests has been established by Humboldt as follows:—
 "They shelter the ground against the sun's rays, they maintain it in a greater degree of humidity, and facilitate the decomposition of the leaves and litter, which they change into humus; and they act as a cooling cause by producing active aqueous transpiration from the leaves and by multiplying in the expansion of their branches, the surfaces warmed by the solar heat, and the surfaces cooled by nocturnal radiation. In regard to the action last mentioned, positive experiments show that the layer of atmosphere in contact with a meadow or a field covered with herbage or vegetable leaves, becomes cooled by nocturnal radiation, other things being equal, several degrees below the temperature of the atmosphere at some meters above, while nothing of this kind takes place over a naked soil, which becomes warm or cool according to the nature of its component parts. We will add, as we have demonstrated, that the leaves as well as the trunk and branches become warmed by solar heat, and retain into the night a portion of this acquired heat. This effect should counterbalance the cooling from nocturnal radiation. We have not thus far

taken account of the fact that the warming of the trees by the sun has a considerable effect upon the temperature of the atmosphere outside the woods as well as within them."

INFLUENCE OF WOODLANDS UPON SPRINGS, RIVERS, AND STREAMS, AND IN CAUSING DROUGHTS.

Professor Hough says :—"It is a matter of common remark that our streams diminish as the woodlands are cleared away, so as to materially injure the manufacturing interests depending upon hydraulic power, and to require new sources of supply for our State canals and for the use of cities and large towns. Many streams once navigable are now entirely worthless for this use.

"The mode in which this influence operates will be readily understood when we consider the effect of forests upon the humidity and temperature of the air.

"A deciduous tree during the season when in foliage is constantly drawing from the earth and giving off from its leaves a considerable amount of moisture, and in some cases this amount is very great. This change of state from a fluid to a gaseous condition is a cooling process, and the air near the surface, being screened from the sun and from the winds, becomes by this means so humid that a rank, succulent vegetation springs up and thrives, which in an open field would wither and perish in an hour. The air being thus charged with moisture and cooled, does not take up by evaporation the rains which fall, and the soil being more open readily allows the water from melting snows and from showers to sink into the earth, from whence a portion appears in springs and in the swamps, which give rise to rills and streams.

"The air at all times holds more or less watery vapour in suspension, and its capacity for doing so is increased as the temperature is raised, not by a steadily gaining rate, but more rapidly as the heat is increased. There can be no evaporation when the air is saturated with moisture, and no deposit of water in any form until the temperature is reduced to the point of saturation. It is not yet determined as to how far the cooling and moistening influence of a grove may extend. It must depend upon many circumstances, and especially upon the slope of the surface and the direction of the winds. The effect is often apparent to the eye from the freshness of the herbage in adjacent fields for many rods in width."

He also says :—"Woodlands are well adapted to hinder the waters from running off and to favour their passage into the soil. This they do with better effect when they are more densely covered. It is, moreover, certain that the leaves of trees pump up and absorb a large amount of water, and although the soil on which they grow is uncultivated, it is much more susceptible of absorption of rains than bare and uncultivated land.

"Forests contribute so effectually to the detention and preservation of the waters, that springs in some countries flowing through the year have entirely disappeared after the woods had been burned, nor did they reappear until after the verdure had been restored, their existence being closely dependent upon its presence."

I will give a quotation on a very important subject, the amount of moisture evaporated by leaves of trees :—

"The leaves of plants impart by evaporation during the growing season a certain amount of watery vapour to the air. The amount of this evaporation differs, not only in the different kinds of plants, but it also depends in the same plants upon external conditions—the temperature of the air, the intensity of light, and on the amount of moisture in the air and in the soil. The greater the warmth of the air, the more intense the solar light, the drier the air, and the moister the soil, by so much more will plants give off moisture from their leaves, the transpiration under these conditions being more active. In this respect light affects plants to such a degree that even passing clouds will lessen the evaporation. The result of all the observations thus far has been to show that under like circumstances the transpiration is greatest in the direct light of the sun ; that is, less in common daylight, still less in the shade, and least in the night. Risler found

by his investigations that in the lucerne the amount of water evaporated in the sun is four times greater than it is in the shade. The difference of evaporation in the two conditions is with this plant considerably greater than with corn. In some plants, as in the willow, it is, however, very slight. This is no doubt the reason why some plants will thrive better in the shade than others. Transpiration is also diminished by a fall of temperature and an increase in the humidity of the atmosphere. With the decrease of warmth and the lessened influence of light, the transpiration of plants becomes less in autumn, and finally stops entirely, causing the falling of the leaves. The evaporation of the leaves is very slight in a damp or foggy atmosphere, and when the leaves are wet by dew or rain. In the damp air of our hot-houses, and under glass vases, often placed over weakly plants, the amount of evaporation is very slight. It is correspondingly lessened in the shade of trees in the cool and damp air of dense forests and under artificial coverings.

"In order that the leaves of plants may remain fresh and plump, as much water must be taken up by the small fibres of the roots as is lost by transpiration. A constant circulation of water is going on from the roots through the trunk to the branches, and through these and the stems into the leaves. The plants remain in a normal condition whenever the supply of water by the roots and loss by evaporation correspond. Under some circumstances it will occur that the supply of water received through the root is greater than the loss through the leaves, or that the loss is greater than the supply. Instances of the former case are presented in the plant which during the night evaporates less water than it receives from the ground through the roots. The surplus is deposited on the leaves in small drops, which, upon examination, may be found early in the morning even in the hot-houses, which precludes the idea that they are gatherings of dew. Another instance is shown in our deciduous trees in autumn after the fall of the leaves, when, from a relatively warm soil the roots maintain their activity, and continue to receive moisture from the soil, which will remain in the body of the tree, as the organs of evaporation are gone. This explains the reason why there is a greater amount of water in the body of the tree in autumn than there is in summer. It is oftener the case, however, that the amount of water lost is greater than that received, which occasions in herbage and young plants a withering of the leaves. Larger trees are not materially affected by this interruption, as the body of the tree acts as a reservoir of water, from which the trees are supplied for some time. The withering and drying up of plants is not always the result of an insufficient amount of moisture in the soil, but it may occur when, in consequence of a lack of activity in the roots the absorption of water from soil is not proportioned to the loss by transpiration."

Here is a word from California. The *Nevada Enterprise* says:—"It will be but a very short time before we shall be able to observe the effect that stripping the fine forests from the sides and summit of the Sierras will have on the climate of this State and California. In a very few years every accessible tree, even to such as are only of value as firewood, will be swept from the mountains. Even now this has been done in some places. It is to be hoped that a new growth of pines or timber trees of some kind may spring up on the ground that has been cleared, but we do not hear that any such growth has yet started.

"Already one great change has occurred that is evident to the most ordinary observer, which is the speedy melting away of the snow on the mountains. It now goes off at once, in a flood, with the first warm weather of spring, whereas formerly, lying shaded and protected by the pines and other evergreen trees, it melted slowly, and all summer sent down to the valleys on both the eastern and western slopes of the Sierras constant and copious streams of water. Instead of a good stage of water in our streams throughout summer, as in former times, there is a flood in the spring, and when this is passed by our rivers speedily run down, and being no longer fed from the mountains, evaporation leaves their beds almost dry when the hot weather of summer comes on.

"The mountains being stripped of their trees, there will be nothing to shade the rocks and earth, and both will absorb a sufficient amount of heat from the rays of the sun during the fall, and even until far into the winter, to melt any light snow that may occur.

The result will be that our autumn weather will reach further into winter, until at last we shall have no winter worthy of the name. On the California side of the mountains the effect will be much the same. The hot weather of the valleys will extend over the foot-hills and gradually reach up into the mountains."

The desolation of mountain regions by the clearing of forests and by pasturage of flocks is also strikingly illustrated in the Pyrenees. This region in the last century was almost entirely out of account in the agricultural and commercial reports of France. The slopes were timbered with forests of great extent, which, from wants of markets and ways for transportation, remained unproductive and to some extent unknown. On the top, where forest vegetation ceased, sufficient herbage was found for the pasturage of flocks in summer. The plains were poorly cultivated and inundations were much less frequent and less destructive than now-a-days. As roads came to be opened the profit from sheep and cattle became greater, and the clearing of forests was begun to make room for pasturage, and to some extent for timber, until by degrees the slopes of the mountains were denuded, and the rains having nothing to hinder began to form eroding torrents, the south slopes suffering most because first cleared and directly exposed to the sun's heat. The extremes of flood and drought became excessive, and extensive tracts have been ruined for present occupation from this source.

The Island of St. Helena, the well-known scene of Napoleon's banishment, furnishes a remarkable illustration of the connection that exists between forests and rainfall. When first discovered in 1502 it had heavy forests. The introduction of goats and other causes destroyed these woodlands until the island was almost denuded. The consequences were that in the records of the last century we find accounts of repeated and almost periodical visitations of very severe drought, occasioning various losses to cattle and crop efforts. Toward the end of the last century, however, the governor saw the need of strenuous efforts, gardeners were sent for, and trees from all parts of the world were planted, without regard to their character. The "Pinas Pinaster" was sown very extensively, and several plantations of this still exist. The consequences of this were discovered a few years since as follows:—"For many years past, since the general growth of our trees, we have been preserved from the scourge, and droughts such as were formerly recorded are now altogether unknown. We have no means, however, of otherwise comparing the rainfall of the two periods, as no tables or even estimates of the rainfall can be had for the earlier dates. Our fall of rain now is equal to that of England, and is spread almost evenly over the year. The showers fall more heavily in two or three months of the year. But this period, though called on this account the rainy season, is in no way to be compared to what is understood by an inter-tropical rainy season."

The Island of Ascension furnishes another remarkable instance. This island, some seven and a-half miles long and six wide, was entirely barren when first occupied in 1815, and so destitute of water that supplies were brought from England and the Cape of Good Hope. Means have since been taken to plant trees and introduce agriculture on the island, though not to any great extent, the effect has been most remarkable. The island grows forty kinds of trees, where but one tree grew in 1843, owing to want of water. The water supply is excellent, and the garrison and ships visiting the island are supplied in abundance with vegetables of various kinds.

In Ceylon the planting of tea and coffee a few years since became an object of active and to some extent speculative enterprise, the soil and climate being alike adapted to both and with more profit to any other vegetable products previously grown. This led to the extensive cutting off of forests, to such extent that there was reason to fear that districts hastily cleared under these inducements might be so changed that there could not be a few years' cultivation. Dr. J. D. Hooker, of the Royal Kew Gardens, to whom reports had been sent, in a letter dated May 27, 1873, to the Earl of Kimberley, calling special attention to the consequences likely to follow this improvidence, says :—

“ It is principally on climatic considerations that the cutting down of forests seems to require Government supervision. There is good reason to think that in tropical countries the removal of wood operates effectively in reducing the rainfall. There can at any rate be no doubt that the presence of forests plays a most important part in storing the rainfall and yielding up gradually to the streams a continuous supply of water, a thing, I need hardly say, in a hot country, of primary importance. Moreover, the rain is retained by forests on the surface of the ground ; it gradually permeates to the subsoil, and so feeds the underground water-bearing strata upon which springs and wells must eventually depend. If the forest is indiscriminately removed the rain runs off as fast as it falls, and washes away the superficial and fertile soil with it.

“ The mischief already done in Mauritius and various West India islands is so widely spread (being in some, indeed, irreparable), and the feeling of the colonists against any interference on the part of the Government is apt to be so determined that I venture to press upon your lordship my own opinion as to the urgency of active steps being taken in the case of an island so beautiful and at present so fertile as Ceylon. I have lately received an account of the deterioration of the climate of some of the leeward islands, which affords a melancholy confirmation of what I have urged above.

“ The contrast between neighbouring islands similarly situated is most striking. The sad change which has befallen the smaller ones is without any doubt to be ascribed to human agency alone. It is recorded of these that in former times they were clothed with dense forests, and their older inhabitants remembered when the rains were abundant and the hills and all uncultivated places were shaded by extensive groves. The removal of the trees was certainly the cause of the present evil. The opening of the soil to the vertical sun rapidly dries up the moisture and prevents the rain from sinking to the roots of the plants. The rainy seasons in these climates are not continuous, cloudy days, but successions of sudden showers, with the sun shining hot in the intervals. Without shade upon the surface, the water is rapidly exhaled, and springs and streams diminish.

“ It is not, however, simply to the restriction of the removal of existing forests that I would venture to direct your lordship's attention, but also to the object, no less important, of making new plantations of forest trees useful for timber and in the arts. Such plantations would serve the double object of retaining the desired humidity and of yielding a revenue to the island.”

The Khanate of Bucharia presents a striking example of the consequences brought upon a country by clearings. Within a period of thirty years this was one of the most fertile regions of Central Asia, a country which when well wooded and watered was a terrestrial paradise. But within the last twenty-five years a mania of clearing has seized upon the inhabitants, and all the great forests have been cut away, while the little that remained was ravaged by fire during a civil war. The consequences were not long in following, and have transformed this country into a kind of arid desert. The water-courses are dried up and the irrigating canals empty. The moving sands of the desert being no longer restrained by barriers of forest are every day gaining upon the land, and will finish by transforming into a desert as desolate as the solitudes that separate it from Khiva.

In the calculations concerning the influence of forests on the rainfall and vegetation of a country, the world has suffered from a lack of scientific observations, no country having for a number of years in succession employed meteorologists to make the requisite observations. In this matter of late years Bavaria has moved to great purpose, and has secured already a large amount of valuable data. From these I make the following quotations, which if carefully read will give my readers valuable facts lately ascertained by the Bavarian Government :—

“By direct observation, it being shown with certainty, that the evaporation in forests covered with litter is very much less than that of naked soil under like circumstances, there can be no longer a doubt that not only forests, but also the litter that covers the surface, contribute largely to the retention of moisture in the earth and to the feeding of springs. The total mean loss of moisture in litter-covered forest soil during the months from April to October inclusive, 1869, was sixty-two per cent., and in 1870, fifty-eight per cent., less than in soil free from litter. If we compare these percentages with the preceding, we find this most interesting result ; that the litter covering contributes as much to the retention of moisture in the soil as forests themselves. In very rainy seasons this influence is less than in dry years. From this it is seen how important it is to retain a protecting covering of moss or leaves on the soil especially upon mountain slopes, where, without litter, or even without woods, but very little water penetrates the soil, the water for the most part running off into the valleys.

“A knowledge of the amount of precipitation (rain, snow, fog, and dew) during the year has a practical as well as a scientific interest, because not only is the height of mean water in our rivers governed by the amount of rain and snow, but also the yield of our crops is largely dependent upon the amount of moisture in the earth. Each plant during its life, uses a considerable amount of water as compared with its weight, and this is derived mainly from the soil. In great drought the plant either dies, or is developed but poorly, forming few roots and few leaves and seeds. In fertilized soils it may thrive better, but without sufficient moisture its vital powers decline. According to the careful investigations of Hellriegel it appears, that in sandy soils and in dry regions, the size of our crops depends more upon the amount and distribution of rain than any other factor. Although generally a greater warmth of the air acts favourably upon the development of plants, it certainly does no service unless the soil receives a corresponding amount of rain.

“The action of the water begins with germination and continues till the formation of the fruit. In the early summer months the grass will wither in the meadows, the herbs and young plants will dry up, the leaves and blossoms of trees will droop, and the half-ripe fruit fall. But how suddenly plants will revive when a long-delayed rain falls on the arid earth ! The forester knows from experience the injuries caused by drought. He knows that forest vegetation demands a certain minimum of yearly precipitation, which must be relatively greater in warmer and drier climates and soils. He also knows that the growth of wood is greater in moist and moderately warm years than in hot and dry seasons ; in fact, the growth of forest trees and their propagation is governed in a very large degree by the distribution of moisture.

“The great claims which trees make upon the moisture in the soil are explained by the circumstance that they contain a large amount of water, which forms the principal part of their sap, and a part of the wood fibre, cells and other organic parts. Starch, chlorophyl, etc., are saturated with water. It is by its agency that the functions of nutrition and growth are carried on. This want is greatly increased by the enormous evaporation constantly going on through the leaves, etc., during the growing season especially in the day-time, which passes off into the air as an invisible vapour, and must be replenished from the soil through the agency of the roots, or they wilt and die. The tree is, in one sense, a stream of water, which, during the growing season is moving from the fibres of the roots, through the outer body of wood into the limbs and branches and into the leaves. The forests thus withdraw a great amount of water from the soil and give it off as vapour. In winter the process is partially suspended, but still there is a

certain degree of activity in the roots. They lay up a supply of aliment in the wood, which serves to keep them alive at a time when grass and herbs would die, and from the depth to which the roots penetrate, they are able to draw water from deeper strata which never become dry, and may thus be able to endure the driest seasons. The amount of water which plants and trees need to sustain life, depends mainly upon the growth and evaporation. The latter differs in the same plant according to age, size, and location, as well as conditions of soil, amount of light, and motion of the air. We have as yet no reliable results as to the amount of water which different forest plants and trees under various circumstances lose by evaporation. This is a subject which deserves our attention in the highest degree, and furnishes a rich subject for forest experimental stations. While Unger found that water would evaporate three times the amount of a plant of the same surface, Schleiden concludes that a forest evaporates at least three times as much water as a water-surface of like area. According to Hartig, a forest evaporates less than free water or wet earth. In hot summer days some plants will evaporate their own weight. In fact, forests afford, and some species of trees, more than others, a kind of vertical drainage of water from the soil.

“With respect to the relative amount of water falling in the fields and forests, it was found uniformly greater at the surface of the earth in the former than the latter, for the manifest reason that a part was intercepted by and evaporated from the foliage of the trees. The percentage in the woods as compared with the fields, varied in different years, by seasons, from forty to ninety, being on the general average of all stations, and, for the whole period least in spring and most in winter. These results will be found to agree with those obtained at other stations, and the rule would doubtless apply to all countries and to every period of time.

“The foregoing statements show how closely related in a country, are its wealth in forests and water (as shown by the great influence of the former), and the litter that covers the surface, to the evaporation and moisture. It therefore need not surprise us that springs and brooks dry up or flow only periodically, and that the mean height of water in rivers and large streams lessens when large surfaces are cleared up, or that springs flow more abundantly and regularly when, by replanting, the extent of forests is increased. The influence of forests, and of litter-covering on the moisture of the soil, founded upon these observations, may be expressed not only in percentages, but we may be allowed to draw conclusions from small to great, as they afford the means for estimating the loss of water in the soil, caused by large clearings and the taking off of litter from any given surface.”

As I am endeavouring to present in this compilation as good an idea as is available of what has been done in this matter of late years, in different countries, (for the world in general appears to be becoming aware of the loss of its timber), I will now give an opinion relative to the Indian forests from a source which should command attention. It is from a valuable work entitled “India in 1880,” by Sir Richard Temple, Bart., G.C.S.I., C.I.E., D.C.L., late Governor of Bombay, Lieutenant-Governor of Bengal, and Finance Minister of India (a work with which, by the way, I was furnished by the kindness of Mr. Goldwin Smith):—

Of his qualifications for writing such a work, the author says:—“If, in undertaking to give such a description from my own knowledge, I shall seem presumptuous, I may state that the demands of public duty have compelled me to visit every part of the Indian Empire, from Thibet to Ceylon, from the Khyber Pass to the frontier of Ava, from the valley of Asam to the city of Candahar. It has been my fate to serve in the three Presidencies of Bengal, Madras, and Bombay, and in every province of the empire with one exception, to be brought in contact with the Native States and the North-West frontier, and to be employed in some capacity or other under all the departments of the State. These circumstances are mentioned in order to show how the materials have been acquired upon which this volume is founded. I have, with trifling exceptions, not only beheld, but

made sketches of every scene which is described in these pages. I have been from first to last concerned in, or otherwise personally cognizant of almost all the affairs which are here discussed." Concerning the forests of India, Sir Richard says:—

"The forests of India were vast according to tradition, and have been considerable even during periods of authentic history. During some few centuries they have been shrinking in size and importance, until they are at present inconsiderable for so great an empire as India, which possesses so many ranges of mountains and hills. If the hill-sides generally had slopes which could be cultivated, then the forests as they were gradually cut down and up-rooted, would give place to crop-bearing fields. But the hills are steep, the soil, lying upon rocky strata, is thin, and is speedily washed away by the rains descending violently at certain seasons. The forest is destined by nature to bind the soil with roots, and so to support the lesser vegetation on the ground. Consequently, when the hill-side is denuded of trees, the shrubs, plants, and herbage fail to sustain themselves, and barrenness ensues. The unrestrained clearance of the forests has affected the climate unfavourably, and lessened the supply of moisture in a country already subject to aridity. It has caused wood, a necessary article, to become dear and scarce, and compelled the people to use for fuel substances which ought to be used for manure. It has reduced to a low ebb some valuable portions of the national wealth, and cut off beyond recovery some branches of the imperial resources. For many generations the forests have been felled whenever firewood had to be gathered for the consumption of the villagers, or new lands reclaimed from the hilly slopes, or towns built with styles of architecture in which wood is largely used, more particularly when cantonments for troops had to be formed, or civil edifices constructed. The felling used to be carried on indiscriminately, without any thought of leaving some parts of the forests, or even a few trees here and there, for reproduction in the future. This destructive process was continued under British rule, and became even aggravated under various circumstances. Timber was needed for the building of barracks, and the officers of the public works' department used to make contracts with capitalists for its supply. These officers were unwilling to interfere with the operations of the contractors who, having no abiding interest in the forests, cleared them to the last logs, without regard for the consequences of such denudation. The forests had been so little explored that the local authorities seldom became aware of the mischief that was being done. When railways began to be constructed, sleepers were not, as they now often are, obtained from Northern Europe, but were procured from local forests, through the agency of contractors, who denuded the forests according to the custom which had unfortunately been established in such cases. The Government theoretically deplored the evil so far as they knew its existence; but its real proportions remained long unknown by reason of the ignorance which prevailed in respect to the sites, value and stock of the forests.

"Within the present generation, scientific attention has been awakened, the Government has bestirred itself, and an effective management of forests has been inaugurated. Mischief, practically immense, has been done already, of which some parts are irreparable, or can be repaired only after the lapse of a long time, while others may be remedied within one or two generations. Of the primeval forests there remains several, still intact, enough to constitute a national resource.

"In the lower ranges of the Himalayan mountains, in central India, in the valleys of the Vindhya and Aravali ranges, in the northern and western portions of the Deccan, and in many districts of the Madras Presidency, the forests have been for the most part so long destroyed that their restoration is hardly to be anticipated. But in the higher ranges of the Himalayas, in the central tracts of the Punjab, in the Satpura range, in that hilly region where the Vindhya and Satpura ranges join, in the Eastern and Western Ghat ranges, they are either preserved, or else but partially destroyed, and may still prove very productive. In some parts of the Bengal Presidency, and in many parts of the Presidencies of Madras and Bombay, the remnant of them is still being invaded bit by bit. Many authorities apprehend that the western and southern provinces of India are, owing to the destruction of the forests, threatened with a danger which is feebly checked, and which, if not arrested, may seriously affect the best interests of the country.

"The woods and forests of India from the Himalayas to Cape Comorin comprise, as

might be expected, trees of European kinds ; the cedar, the pine, the fir, the mountain cypress, the juniper, the yew, the oak, the ilex, the elm, the ash, the maple, the plane, the holly, the laurel, the birch, the walnut, the alder. The Asiatic sorts are the acacia, the terminalia, the ebony ; the ficus order including the banyan and the india-rubber tree, the mango, the sandal-wood, the cane, the bamboo, the toon, the neem, the blackwood, the sal ; and greatest of all, the teak. To these should be added the palms, including the feathery date-palm, the palmyra with its fan-like leaves, and the betel-nut palm. The lesser products of the forests, such as myro-balans, and other articles, are also considerable.

“Many believe that the rainfall is copious and seasonable or otherwise, according as the woods and forests, and the vegetation subsidiary to them, are preserved or destroyed, while others disbelieve this view, which at all events must admit of much qualification. But, after all due abatements have been made, the view is generally held to comprise some truth. The total rainfall of the whole country cannot possibly be affected by the existence of forests. The average quantity of vapour must come from the ocean and must be condensed somewhere ; if it be not changed into rain as it passes across the plains, it will pass on to the mountains and be transformed there. This, indeed, is a matter of common experience ; moisture-laden clouds float over the Deccan, leaving it arid, and move on to the Satpura range, and, being condensed there, fill the torrent-beds with rain-water which rushes into the rivers and returns ultimately to the plain in the shape of inundations. Similarly, clouds sweep over the thirsty plains of Hindostan, and being condensed in the Himalayas, return in the form of floods in the great rivers. The hope is that, if forest tracts were distributed over the plains, there would be cool surfaces to attract the clouds and to arrest them, as it were, on their way. There are many tracts where forests, if preserved, would grow up in a short time. Thus it is anticipated by many that the climate would be improved, and that the early and the later rains would descend more seasonably than at present. It is remembered that, throughout the world, those regions which possess rich vegetation receive abundant rains, while those which are denuded of vegetation are rainless. It is remarked, too, that those regions in India, which ordinarily receive rain, but have been parched by a long drought, are plagued afterwards with immoderate rain.

“At all events the forests, and their subsidiary vegetation, husband and store by a natural process the exceeding moisture of the rainy season, for the benefit of the country during the dry season. The streams become better filled and more available for the use of the people ; the springs are less likely to run dry, the wells less liable to failure. This consideration becomes peculiarly important in those regions where the canals for irrigation are drawn from rivers having their source in mountains which depend on the annual rainfall for moisture. Near the springs and along the upper courses of these rivers the vegetation needs especially to be preserved for the sake of the canals.

“The economic considerations relating to the forests are manifestly important, as wood is used largely in the construction of the houses and cottages in most parts of the country. In northern India, where trees are few, the earth, indurated by the sun, affords good material, and the earthen walls are durable, but elsewhere the earth does not always possess a like degree of consistency. For these reasons it is essential that the timber markets should be well supplied. Without interposition by the State, the wood and timber would become scarcer and dearer from time to time, as the forests became exhausted. As coal is not available, the people require wood for fuel ; if they cannot obtain wood they will use cow-dung cakes for burning. The practice of consuming for fuel that which ought to be used for manure in a country too, where artificial manure is not available, extensively prevails, is most injurious, and tends to exhaustion of the soil. The only means of lessening this practice is by preserving the forests to provide a cheap and plentiful supply of wood for fuel.

“Thus the policy of preserving the forests rests on two grounds, first the improvement of the climate and the retention of moisture ; secondly the husbanding of the national resources in timber and fuel for the use of the people. This policy is of much consequence to the well-being of the country and the nation.”

Mr. Marsh says that, concerning the influence of the forest, considered as inorganic matter on temperature :—"The evaporation of fluids and the condensation and expansion of vapours and gases are attended with changes of temperature ; and the quantity of moisture which the air is capable of containing ; and of course, other things being equal, the evaporation rises and falls with the thermometer. The hygroscopical and the thermoscopic conditions of the atmosphere are therefore inseparably connected as reciprocally dependent quantities, and neither can be fully discussed without taking notice of the other. The leaves of living trees exhale enormous quantities of gas and of aqueous vapour, and they largely absorb gases, and under certain conditions, probably also water. Hence they affect more or less powerfully the temperature as well as the humidity of the air. But the forest, regarded purely as inorganic matter, and without reference to its living processes of absorption and exhalation of gases and of water, has, as an absorbent, a radiator, and a conductor of heat, and as a mere covering of the ground, an influence on the temperature of the air and the earth, which may be considered by itself.

"Balance of Conflicting Influences of Forest on Atmospheric Heat and Humidity.

"We have shown that the forest, considered as dead matter, tends to diminish the moisture of the air, by preventing the sun's rays from reaching the ground and evaporating the water that falls upon the surface, and also by spreading over the earth a spongy mantle which sucks up and retains the humidity it receives from the atmosphere ; while, at the same time, this covering acts in the contrary direction by accumulating in a reservoir not wholly inaccessible to vaporizing influences, the water of precipitation which might otherwise suddenly sink deep into the bowels of the earth, or flow by superficial channels to other climatic regions. We now see that, as a living organism, it tends, on the one hand, to diminish the humidity of the air, by sometimes absorbing moisture from it, and, on the other, to increase that humidity by pouring out into the atmosphere, in a vaporous form, the water it draws up through its roots. This last operation, at the same time, lowers the temperature of the air in contact with or proximity to the wood, by the same law as in other cases of the conversion of water into vapour.

"As I have repeatedly said, we cannot measure the value of any one of these elements of climatic disturbance, raising or lowering of temperature, increase or diminution of humidity ; nor can we say that in any one season, any one year, or any one fixed cycle, however long or short, they balance and compensate each other. They are sometimes, but certainly not always contemporaneous in their action, whether their tendency is in the same or in opposite directions, and, therefore, their influence is sometimes cumulative, sometimes conflicting, but, upon the whole, their general effect is to mitigate extremes of atmospheric heat and cold, moisture and drought. They serve as equalizers of temperature and humidity, and it is highly probable that in analogy with most other works and workings of nature, they, at certain or uncertain periods restore the equilibrium, which, whether as lifeless masses or as living organisms they may have temporarily disturbed.

"When, therefore, man destroys these natural harmonizers of climatic discords, he sacrifices an important conservative power, though it is far from certain that he has thereby affected the mean, however much he may have exaggerated the extremes of atmospheric temperature and humidity, or, in other words, may have increased the range and lengthened the scale of thermometric and hygrometric variations.

"Special Influence of Woods on Precipitation.

"With the question of the action of forests upon temperature and upon atmospheric humidity is intimately connected that of their influence upon precipitation, which they may affect by increasing or diminishing the warmth of the air and by absorbing or exhaling uncombined gas and aqueous vapour. The forest being a natural arrangement, the presumption is that it exercises a conservative action, or at least a compensating one, and consequently that its destruction must tend to produce pluviometrical disturbances as well as thermometrical variations. And this is the opinion of perhaps the greatest number of observers. Indeed, it is almost impossible to suppose that, under certain conditions of time and place, the quantity and the periods of rain should not depend, more or less, upon the presence or absence of forests ; and without insisting that the removal of forests has

diminished the sum-total of snow and rain, we may well admit that it has lessened the quantity which annually falls within particular limits. Various theoretical considerations make this probable, the most obvious argument, perhaps, being that drawn from the generally admitted fact, that the summer and even mean temperature of the forest is below that of the open country in the same latitude. If the air in a wood is cooler than that around it, it must reduce the temperature of the atmospheric stratum immediately above it, and, of course, whenever a saturated current sweeps over it, it must produce precipitation which would fall upon it, or at a greater or less distance from it.

"We must here take into the account a very important consideration. It is not universally or even generally true that the atmosphere returns its condensed humidity to the local source from which it receives it. The air is constantly in motion—

——— howling tempests scour amain
From sea to land, from land to sea ;

and, therefore, it is always probable that the evaporation drawn up by the atmosphere from a given river, or sea, or forest, or meadow, will be discharged by precipitation, not at or near the point where it rose, but at a distance of miles, leagues, or even degrees. The currents of the upper air are invisible, and they leave behind them no landmark to record their track. We know not whence they come, or whither they go. We have a certain rapidly increasing acquaintance with the laws of general atmospheric motion, but of the origin and limits, the beginning and end of that motion, as it manifests itself at any particular time and place, we know nothing. We cannot say where or when the vapour, exhaled to-day from the lake on which we float, will be condensed and fall ; whether it will waste itself on a barren desert, refresh upland pastures, descend in snow on Alpine heights, or contribute to swell a distant torrent, which shall lay waste square miles of fertile corn-land ; nor do we know whether the rain which feeds our brooklets is due to the transpiration from a neighbouring forest or to the evaporation from a far-off sea. If, therefore, it were proved that the annual quantity of rain and dew is now as great on the plains of Castile, for example, as it was when they were covered with the native forest, it would by no means follow that those woods did not augment the amount of precipitation elsewhere.

"The whole problem of the pluviometrical influence of the forest, general or local, is so exceedingly complex and difficult that it cannot with our present means of knowledge be decided upon *à priori* grounds. It must now be regarded as a question of fact which would probably admit of scientific explanation if it were once established what the actual fact is. Unfortunately the evidence is conflicting in tendency, and sometimes equivocal in interpretation, but I believe that a majority of the foresters and physicists who have studied the question are of opinion that in many, if not in all cases, the destruction of the woods has been followed by a diminution in the annual quantity of rain and dew. Indeed, it has long been a popularly settled belief that vegetation and the condensation and fall of atmospheric moisture are reciprocally necessary to each other, and even the poets sing of

* * * Afric's barren sand,
Where nought can grow, because it raineth not,
And where no rain can fall to bless the land,
Because nought grows there."

Dr. Schacht, Professor at the University of Bonn, says in his well-known work, "Les Arbres":—

"The snow and ice which accumulate during the winter on the mountains, melt rapidly under the spring sunshine—thus swelling the torrents whose mass of water makes its way into the valleys with resistless force. But when the mountain sides are covered by forests, or where the arable plains are bordered by woods, the scene changes its aspect. The greater part of the snow is deposited on the trees or falls between them, and the water which results is absorbed by the soil formed by the accumulation of vegetable matter ; but wherever the forests have disappeared, the spring inundations of the rivers have

acquired a frequency unknown before. It cannot be disputed that the terrible destructive effects of the inundations of the Loire and the Vistula of late years must be in great part attributed to the excessive denudation of the forests.

"A mountain cliff, a wall, or a forest are the natural protections against the wind. In this respect the forest cannot be without beneficial effect on the adjacent country; the young growth of trees flourishes, screened from the force of the wind, the arable land develops itself better, the shifting sands meet an impassible barrier, and the noxious influence of the dry winds is turned aside.

"It is, then, indisputable that the forests exercise a salutary influence on the temperature of a country. The sanitary condition of man and of domestic animals, as well as the growth of cultivated plants, immediately depends on the climate of the locality. Epidemics, unknown before, may perhaps be attributed to a climatic change brought about by the destruction of forests.

"The fertility of a country depends on its supply of forest land, for on this depend the foundation of soil, the precipitation of dew, and fall of rain, the steady current of rivers, the mitigation of the evil influences of unhealthy winds, and the growth of vegetation in the fields and meadows. The great fertility of certain tropical regions, as we have shown with respect to Madeira and the Canaries, is in great part due to the extension of forest land.

"Cultivated plains and forests are by no means so opposed to each other as that they cannot exist together. The kind of land where one flourishes is by no means always suitable to the other. For example, at a certain altitude of mountains of a rocky nature, cultivation cannot well be carried on, while yet the ground is well suited to forests. Much elevated ground, now covered with crops which scarcely pay for the labour expended in producing them, was formerly wooded. The bed of soil produced by the shade and *debris* of forests has disappeared with them; each new fall of rain has carried away some of its soluble constituents, in each a new loss to the soil which, thus impoverished, becomes at last sterile.

"We are far from asserting that we can do without arable lands any more than forests, it is clearly right to cut down woods when in need of land for culture. But the destruction of forests ought never to exceed its necessary limits, never should some temporary need decide on the fall of a forest, nor should this ever be allowed when wheat is incapable of growing; and wherever a forest is felled, we should always replace it with a new plantation of trees. The prairies, fields of wheat and of other grain, like all vegetables, do exercise an influence both on the soil and in the atmosphere. Nay, more, these would yet further improve the soil, if the harvest and the rotation of crops did not each year remove their supply of organic and mineral nutriment. With these the fields ought to be manured, as the forests are each year, by the fallen leaves. The action of arable fields and meadows on the atmosphere is the same as that of forests, but within much weaker limits, and with a gentler surface of exhalation and absorption. Fields and arable lands cannot supply the place of forests, they cannot retain in as complete a manner the moisture in the soil, or impress in the atmosphere so active a circulation. The proportion between arable lands and forests ought to be based on the special conditions of the soil and climate of a country. This question is one of the most difficult, as it is one of the most interesting problems of political economy, and on its solution depends, to no slight degree, the development and well-being of nations.

"Since Julius Cæsar and the other Roman historians, Germany has been covered by vast forests. It was the same in Spain according to Diodorus Siculus, in Greece according to Herodotus and Thucydides. Under the Roman Empire the forests were banished to the mountains, and were in fact reduced to the condition of plantations. Green oaks and cork trees abounded as did pine along the Guadalquivir.

"*How to reconstruct the forests:*—By culture and care, by well-chosen replanting, by the plantation of new woods. One should never cut down woods excepting when there is need of lumber, or when beneficial to the forests themselves. Trees which have not yet attained the full growth of their development should never be cut down but from absolute necessity. The plantations of old trees should be sacrificed; their development is at an end, and the soil will profit more by a new plantation. When woods are cut

down the ground should never be left unoccupied. There is no difficulty in establishing a new forest on ground of good quality and well protected ; but this is hard, if not impossible on soil impoverished or exposed to the heat of the sun or violence of wind. Yet it is the plantation of such land as this which is generally undertaken by Governments. The difficulty is three-fold :—1. Absence of soil. 2. Want of shade in summer. 3. Cold winds in autumn and winter. Against the first of these, our principal resource is to plant in sufficient quantity those plants which, like the sand grass, by the interlacement of their root-fibres, prevent the nutritive elements of the soil from being drained away by the rains. It is probable that the net of mesh-work formed by their roots will at last solidify the soil, which will also profit by the continuous deposit of clay. After these preliminary operations, one can begin to plant trees.

“The pine, birch, aspen, alder, are well able to bear the heat of the sun, and should be planted first, then the oak, witch-elm, etc., in their shade.”

It will be valuable for our purpose to notice Mr. Marsh's statement respecting snow :—

“Whenever the humidity of the atmosphere in contact with snow is above the point of saturation at the temperature to which the air is cooled by such contact, the superfluous moisture is absorbed by the snow or condensed and frozen upon its surface, and of course adds so much to the winter supply of water received from the snow by the ground. This quantity, in all probability, much exceeds the loss by evaporation, for during the period when the ground is covered with snow, the proportion of clear dry weather favourable to evaporation, is less than that of humid days with an atmosphere in a condition to yield up its moisture to any bibulous substance cold enough to condense it.

“In our Northern States, irregular as is the climate, the first autumnal snows pretty constantly fall before the ground is frozen at all, or when the frosts extends at most to a depth of only a few inches. In the woods, especially those situated upon the elevated ridges which supply the natural irrigation of the soil and feed the perennial fountains and streams, the ground remains covered with snow during the winter ; for the trees protect the snow from blowing from the general surface into the depressions, and new accessions are received before the covering deposited by the first fall is melted. Snow is of a colour unfavourable for radiation, but, even when it is of considerable thickness, it is not wholly impervious to the rays of the sun, and for this reason, as well as from the warmth of lower strata, the frozen crust of the soil, if one has been formed, is soon thawed, and does not again fall below the freezing-point during the winter.

“The snow in contact with the earth now begins to melt, with greater or less rapidity, according to the relative temperature of the earth and the air, while the water resulting from its dissolution is imbibed by the vegetable mould, and carried off by infiltration so fast that both the snow and the layers of leaves in contact with it often seem comparatively dry, when, in fact, the under surface of the former is in a state of perpetual thaw. No doubt a certain proportion of the snow is given off to the atmosphere by direct evaporation, but, in the woods, the protection against the sun by even leafless trees prevents much loss in this way, and besides, the snow receives much moisture from the air by absorption and condensation. Very little water runs off in the winter by superficial water-courses, except in rare cases of sudden thaw, and there can be no question that much the greater part of the snow deposited in the forest is slowly melted and absorbed by the earth.

“The immense importance of the forest, as a reservoir of this stock of moisture, becomes apparent, when we consider that a large proportion of the summer rain either flows into the valleys and the rivers, because it falls faster than the ground can imbibe it ; or, if absorbed by the warm superficial strata, is evaporated from them without sinking deep enough to reach wells and springs, which, of course, depend much on winter rains and snows for their entire supply. This observation, though specially true of cleared and cultivated grounds, is not wholly inapplicable to the forest, especially when, as is too often the case in Europe, the underwood and decaying leaves are removed.

“The quantity of snow that falls in extensive forests, far from the open country, has

seldom been ascertained by direct observation, because there are few meteorological stations in or near the forest. According to Thompson, the proportion of water which falls in snow in the Northern States does not exceed one fifth of the total precipitation, but the moisture derived from it is doubtless considerably increased by the atmospheric vapour absorbed by it, or condensed and frozen on its surface. I think I can say from experience—and I am confirmed in this opinion by the testimony of competent observers whose attention has been directed specially to the point—that though much snow is intercepted by the trees, and the quantity on the ground in the woods is consequently less than in the open land in the first part of the winter, yet most of what reaches the ground at that season remains under the protection of the wood until melted, and as it occasionally receives new supplies, the depth of the snow in the forest in the latter half of the winter is considerably greater than in the cleared fields. Careful measurements in a snowy region in New England, in the month of February, gave a mean of thirty-eight inches in the open ground and forty-four inches in the woods.

“The general effect of the forest in cold climates is to assimilate the winter state of the ground to that of wooded regions under softer skies; and it is a circumstance well worth noting, that in Southern Europe, where nature has denied to the earth a warm winter garment of flocculent snow, she has, by one of those compensations in which her empire is so rich, clothed the hill-sides with umbrella and other pines, ilexes, cork-oaks, bays, and other trees of persistent foliage, whose evergreen leaves afford to the soil a protection analogous to that which it derives from snow in more northern climates.

“The water imbibed by the soil in winter sinks until it meets a more or less impermeable or saturated stratum, and then, by unseen conduits, slowly finds its way to the channels of springs, or oozes out of the ground in drops which unite in rills, and so all is conveyed to the larger streams, and by them finally to the sea. The water, in percolating through the vegetable and mineral layers, acquires their temperature, and is chemically affected by their action, but it carries very little matter in mechanical suspension.

“The process I have described is a slow one, and the supply of moisture derived from the snow, augmented by the rains of the following seasons, keeps the forest ground, where the surface is level or but moderately inclined, in a state of approximate saturation throughout almost the whole year.

“It may be proper to observe here that in Italy, and in many parts of Spain and France, the Alps, the Appenines, and the Pyrenees, not to speak of less important mountains, perform the functions which provident nature has in other regions assigned to the forest—that is, they act as reservoirs wherein is accumulated in winter a supply of moisture to nourish the parched plains during the droughts of summer. Hence, however enormous may be the evils which have accrued to the above-mentioned countries from the destruction of the woods, the absolute desolation which would otherwise have smitten them through the folly of man, has been partially prevented by those natural dispositions by means of which there are stored up in the glaciers, in the snow-fields, and in the basins of mountains and valleys, vast deposits of condensed moisture which are afterwards distributed in a liquid form during the season in which the atmosphere furnishes a slender supply of the beneficent fluid so indispensable to vegetable and animal life.”

An elegant French writer upon forest economy, Jules Clavé, in a work entitled “*Études sur l'Economie Forestière*,” thus clearly describes the processes of nature by which forests maintain and equalize the flow of waters:—

“*Rains*.—The first phenomenon that offers for our inquiry, in the study of the regulation of the waters, is rain. It is this that gives rise to springs and rivers, and that in certain conditions of continuance occasions inundations.

“Rain is caused by the precipitation of the vapour held by the atmosphere, and this precipitation is commonly caused by cold and humid winds. When these winds come to us (in France) from the ocean or the Mediterranean, and pass over a place where the temperature is too low to hold these vapours in suspension, they condense and fall as rains.

"It has been claimed that the presence of forests, like mountains, have the effect of lowering the temperature, and by this means of increasing the abundance of rains as well as of diminishing their violence. It cannot be doubted that forests have the effect of sheltering the surface from solar heat, and of causing a cutaneous exhalation from the leaves, while they multiply, by the spreading of their branches, the amount of surface cooled by this evaporation, and thus have a cooling effect; but this, in fact, is far from being general, and especially in our climate it is often marked, and even neutralized, by local circumstances, such as the physical properties of the soil, the topographical situation of the place, the direction of prevailing winds, etc. If it is certain that the mean temperature of our country is higher than was in Gaul in the days of Cæsar, when it was covered with forests, we must nevertheless admit that while a forest protects the surface from cold winds it does not tend to raise the temperature, and that if cut away a refrigerator would not be thereby necessarily produced. Thus, for example, it has been proved that the department of *l'Ardeche*, which is now without a single considerable piece of woods, has shown during the last thirty years a perturbation of climate, of which late spring frosts, formerly unknown in the country, are among the saddest effects. A similar remark may be made in the plains of Alsace, since the denudation of several of the crests of the Vosges."

"*Tropical Forests.*—On the contrary, in countries within the tropics, where the nights are usually very serene, the radiating power of plants is sensibly increased, and the energy of other frigorific causes are developed in the same proportion, so that the presence of forests tends uniformly to reduce the temperature. This fact was proved by numerous observations given in M. Boussingault's work on the region included between the eleventh degree of north and fifth degree of south latitude, and it effectually explains the reason why America is not so hot as Africa within these latitudes.

"The action of forests upon rainfall, through the influence which they exert upon the temperature, is therefore very difficult to determine in our country; but it is distinctly marked in warmer climates, as proved by numberless examples. M. Boussingault reports that in the region comprised between the Bay of Cupica and the Gulf of Guayaquil—a district covered with immense forests—the rains are almost continual, and that the mean temperature of this humid country is scarcely above 79° F. M. Blanqui, in his travels in Bulgaria, mentions that at Malta the rains have become so seldom, since the trees have been cut away to make room for cotton, that at the time of his visit in October, 1841, not a drop of rain had fallen during three years. The fearful dryness which has desolated the Cape Verde Islands may be, in like manner, attributed to the cutting off of forests. On the island of St. Helena, where the wooded surface has considerably increased within the last few years, they observe that the amount of rain increases in the same proportion, and it is now double that which fell annually at the time of Napoleon's sojourn there. Lastly, in Egypt, the recent plantations have brought rains where they were almost unknown before.

"In the midst of this uncertainty in which our climate is left, by the study of meteorology—for the hygrometrical operations made at different points in France have yielded results too diverse to serve as the foundation of any theory—we will come to limit our study of the action of forests to the regulation of the water courses in the single point of view which their mechanical and physical laws present."

"*Rains, how disposed of in Forests.*—The rains which fall upon our continents are disposed of as follows:—A part runs from the surface into the streams that carry it back to the sea. Another part is evaporated soon after its fall and returns to the atmosphere, and another part is absorbed by the ground. The first and third of these exclusively go to feed the springs and rivers, while the second is wholly withdrawn from our calculation. This feeding of the water courses is more or less regular or constant, according as it finds a superficial or underground passage-way, and therefore depends not only on the physical properties and the topographical contours of the soil, but also upon the vegetation with which it is covered.

"Under ordinary circumstances, the superficial flow produces no effect except upon soil where the slope is considerable and quite impervious to the water, such as denuded

rock or compact clay. It contributes, only in a very irregular manner, to the feeding of rivers and streams, as it delivers considerable volumes at certain times, and becomes nothing as soon as the rain ceases. But, on the contrary, when the soil is permeable, it absorbs all the water that falls, and does not deliver it again at the surface until some days after the rain, if completely absorbed. It is then that the action of forests begins to be felt. But if, in fact, the soil is uncovered, the liquid volume descends with a velocity proportionate to the slope, and brings with it the materials of every kind that obstruct its course, at the same time increasing its volume and destructive power. If these form torrents of limited ravage when the rainfall is local, they become fearful inundations when it is more general in extent. But, on the contrary, if the soil is covered with woods the flow is more gentle. Being arrested at every point, broken by the trees, their branches, and the mosses which it encounters on the way, the water arrives at the bottom of the valley much slower, without erosions, and without bringing with it any foreign substances. The forest, therefore, in hindering the delivery of the water, lessens the chances of engorgement."

"*Evaporation.*—We know that evaporation is going on at all temperatures, with greater or less rapidity, whenever the surrounding air is not already saturated with moisture. All other things being equal, it is greater when the ground is cleared than when covered with forests, because the latter arrest the action of the winds and prevent the masses of air, when saturated, from being renewed, and keeps the temperature lower by shielding the surface from the sun's heat. In lessening the amount of water evaporated, it by so much increases the quantity that is absorbed. It is, moreover, needless to insist upon a fact which everybody knows—for no one can be ignorant of the fact—that the soil in a forest after a rain remains wet much longer than where the surface has been cleared.

"Evaporation can only take place when, at a given temperature, the air is not saturated with moisture. But the rains themselves prove that there is an excess of saturation in the air at the time, and therefore there can be no evaporation when it rains. They can, therefore, have no very serious influence upon inundations properly so-called, and in this regard cleared lands present no advantage over others."

"*Absorption.*—A part of the water which falls is absorbed by the soil. Some of this is used by the vegetation, and serves to carry into the tissues of plants their soluble mineral elements, and is then returned in a certain degree to the atmosphere by the exhalations of the leaves. Another portion filters slowly into the soil till it meets an impervious stratum, and then flows along this bed, following its undulations, till it appears at the surface in the form of springs, unless it is drawn down into the depths of the earth's crust. It is this part alone, which is absorbed by the earth, that feeds the springs and furnishes the aliment of rivers. Every cause which tends to increase, to its detriment, the evaporation or pure loss of water, or to augment the superficial flow, has to this extent an influence upon the regulation of the water flow, and in this regard forests exercise a most important influence. All soils are not equally permeable. Some, as in the oolitic formation, absorb nearly all the rain that falls upon their surface. Others, like the primary rocks and liassic soils, allow rain to penetrate only so far as they are covered with vegetable mould. It is implied, therefore, that these vegetable beds should be preserved at the highest points, since they tend to increase the subterranean contingent of a part of the water, which, without its presence, would flow off upon its surface. But forests serve marvellously the functions of fixing the soil upon the steepest slopes. There will be no need of conviction upon this point to one who shall pass over the Alps or Pyrenees, where every peasant knows that to consolidate the banks of the brooks that cross his fields, and to prevent the gullying of the slopes of the roads, he has only to plant a few trees. Who does not, moreover, know the cohesive power of grass turf in fostering the roots of plants? The forests are turf upon a large scale, in which the blades of herbage are replaced by trees, of which the roots strike two or three yards into the soil. They can, therefore, oppose an invincible resistance to this washing away of the soil. According to M. Brougniart, the roots of trees contribute to augment the permeability of certain soils by offering a kind of vertical drainage."

"Clay Soils.—Nor is this all. When the soil is carried away, it confines a certain proportion of clay, which, when moistened to a depth which, according to M. Becquerel, does not exceed six times the depth of the sheet of falling water, it forms a natural cup, its pores being obstructed mechanically by the rains which harden them. It is then impermeable, and free to deliver, by superficial flow, all the liquid that has not been absorbed. But when, on the contrary, the surface is covered with forests, the dome of foliage breaks the force of the rains, which only reach the soil in a state of minute division, and this impervious condition cannot then take place to hinder effective absorption. Finally, by the humus which they produce, forests increase the absorbent qualities of different soils, and consequently the amount of liquids with which they may be charged. This absorbent quality is about twenty-five per cent. in weight in sandy soils, and varies from fifty to ninety per cent. for argillaceous soils, and in humus it rises to one hundred and ninety per cent.

"We must admit," says M. Hun, "that the sheet of water produced by the heaviest rains scarcely exceeds 3.9 inches in depth. But the bed of soil in a well-stocked forest comprises a layer of humus over a great part of the surface of more than double this depth. In speaking of forests I do not refer to the thin and ruined woods to which this name has been improperly applied; but to the timber lands like the forests belonging to the state, and to all the communal forests in the eastern departments, where the soil has a capacity for absorption greater than the volume of water yielded by the heaviest showers. From this we may explain the fact that after a deluging rain, the water-courses issuing from a well-stocked forest, show only a moderate increase in their volume, and that they keep this up for quite a time, their transparency being scarcely affected."

"General Conclusions:—Thus, to resume our subject, forests hinder the superficial flow, or delay its progress; they hinder evaporation, and in a rain of given amount they tend to increase the portion that is absorbed by the soil, and to diminish the surplus flow, which is lost without profit.

"The data of the problem being stated, it is easy to adduce the conclusions. If we assume that the mean annual number of rainy days is 120 and of dry days 244, it follows that, in order that the rivers shall always keep at a constant level, the time required for the flow of their waters should be nearly three times greater than that in which they fell as rain. It would be necessary, therefore, that they should be stored in a reservoir of which the outlet should only be one-third as great as the inlet, thus allowing the waters to escape in a time three times as long as that in which they are received. If the flow takes place more rapidly, the reservoir will be dry for a season, after having flowed in excessive abundance, which might cause either a local or a general inundation. If, on the contrary, the flow is not so fast, it will not discharge in a proper time all the liquid mass, and there will be an engorgement producing marshes, and finally inundations. Thus, an undue excess of rapidity or of slowness in the discharge of rainwater will cause, as we shall hereafter see, either from an absence from an extreme abundance of forests, the same results.

"Forests retard the flow of waters:—Forests, by favouring absorption, allow only the minimum of waters to be liberated. Moreover, in prolonging the discharge of the liquid absorbed, they extend the time required for its flowing off, and serve like a reservoir, of which the springs are the outlets, and thus insure the regular feeding of the water-courses. Denuded soil, on the contrary, allows a part of this water to escape both by evaporation and by superficial flow, retaining only imperfectly what it absorbs, and allows the sun's rays to pump up the moisture from the lower beds. For these reasons the springs become dry in summer and the rivers engorged in winter.

"Examples near at home:—But why should we seek so far away for the proofs of phenomena that are renewed daily under our eyes, and of which any Parisian may convince himself without venturing beyond the Bois de Boulogne or the forest of Meudon? Let him walk out, after some days of rain, along the Chevrencé road, bordered on the right by the forest of Meudon, and on the left by cultivated fields. The amount of rain

that has fallen is the same on both sides, and yet the ditches by the roadside along the edge of the forest will be still filled with water, proving the infiltration going on from the wooded soil, while, already for some time, those on the other side, adjoining the cleared fields, will have been dry, after having served their purpose by a sudden flow. The ditch on the left will have emptied itself in a few hours of all the water, which the one on the right will take some days to convey to the bottom of the valley.

“*Direct effect of Forests Illustrated* :—To those examples we may add another which appears to us to be characteristic. It is due to the observations of Mr. Cantegril, sub-inspector of forests, and was communicated by him to the *Ami des Sciences*.

“Upon the territory of the commune of Labrugnière there is a forest of 1,834 hectares, (4,524 acres), known as the forest of Montant, and owned by the commune. It extends northward on the Montagne-Noire, and the soil is granitic with a maximum altitude of 1,243 meters, and a slope of from fifteen to sixty in one hundred. A little water-course, the Caunan brook, rises in this forest and drains the waters of two-thirds of its surface. At the entrance of the forest, and along this brook, will be found several fulling mills, each requiring eight horse-power, and moved by water-wheels which work the beaters of the machines.

“The commune of Labrugnière had long been noted for its opposition to the forest regulations, and the cutting of wood, together with the abuse of pasturage, had converted the forest into an immense waste, so that this great property would hardly pay the cost of guarding it, and afford a meagre supply of wood for its inhabitants.

“While the forest was thus ruined and the soil denuded, the waters after each heavy rain swept down through the valley, bringing with them great quantities of gravel, the *débris* of which still encumbers the channel of this stream. The violence of these floods was sometimes so great that they were compelled to stop the machines for some time. But in the summer time another inconvenience made its appearance. Little by little the drought extended, the flow of waters became insignificant, the mills stood idle, or could be run only occasionally for a short time.

“About 1840, the municipal authorities began to inform their population relative to their true interests, and under the protection of a better supervision, the work of replanting has been well managed, and the forest is to-day in successful growth.

“In proportion as the replanting progressed, the precarious use of the mills ceased, and the regulation of the water-courses was totally modified. They now no longer swelled into sudden and violent floods, compelling the machines to stop; but the rise did not begin until six or eight hours after the rains began. They rose steadily to their maximum, and then subsided in the same manner. In short, they were no longer obliged to stop work, and the waters were always enough to run two machines, and sometimes three.

“This example is remarkable in this, that all the other circumstances had remained the same, and therefore we could only attribute to the reforesting the changes that occurred, namely, diminution of the flood at the time of rain, and an increase in its flow during common times.

“We may readily from the preceding account for the part which forests act in heavy and long-continued rains as to the floods then produced. Before reaching the soil and being completely absorbed, the rain must pass through the dome of verdure formed by the leaves, which they wet, thus causing the first appropriation of the waters. Then we must add the results of great permeability of wooded soil, and the great absorption of which the humus of forests is capable, so that until these demands are supplied no water can run from the surface.

“The flow will be slower and with less destructive force than in cleared fields, on account of the obstacles of every kind which the liquid mass meets in its course, so that it will not reach the bottom of the valley until after the rain which fell in the lower parts shall have been discharged.”

“*Review of M. Vallès' Book* :—In a very remarkable work entitled, “*Etude sur les inondations, leurs causes et leurs effets*,” published in 1857, M. Vallès an engineer of *ponts et chaussées* contradicts the efficacy of reforesting as a means of preventing inundations.

In giving an account of this work in the *Annales forestières*, M. A. F. d' Héricourt combats these assertions in a victorious manner, and proves conclusively that the reforestation of a portion of the upper basin of the Loire would have prevented the inundation of 1846.

"Accepting," says he, "the data of M. Vallés, who has analyzed with much care the various phenomena which characterized the flood of October, 1846, in the upper basin of the Loire, I will admit with him, that if we could have held back 175,000,000 cubic meters of water, the inundation which proved so sad a calamity to France would not have presented so painful an event. The upper basin of the Loire, as far as Roanne, comprises an area of 640,000 hectares, (158,080,000 acres) of which at least a third say 213,000 hectares (52,693,000 acres) might be profitably reforested. This inundation was caused by a rain which lasted sixty hours, and poured upon the soil a sheet of water 153 millimeters (about six inches) in depth. This portion of the basin of the Loire, therefore, received 979,200,000 cubic meters of water. On the hypothesis of M. Vallés, 244,800,000 cubic meters were absorbed. There accordingly remained for superficial flow 734,400,000 cubic meters.

"But, let us suppose that in 1846, the 213,000 hectares above mentioned to have been covered with massive woods, and then let us calculate what would have happened. These 213,000 meters would have received as their share 290,000 cubic meters. The absorbent qualities of the soil are increased forty per cent. by reforestation, and this operation would have withdrawn 130,116,000 cubic meters from the superficial flow, which would have reduced the amount upon the retimbered portions to 195,174,000 cubic meters. But this liquid mass would have been hindered in its course down the valley, as we have above explained, by the passive resistances of every kind which the forest presents, and a half, at least, would not have arrived until the other half, which had fallen in other parts of the basin had passed off. We may, therefore, conclude that the superficial flow would not have exceeded 500,000 cubic meters, and that the calamities occasioned by the inundation of 1846 would have been completely prevented by reforestation."

*"Snows Retard the Flow of Waters:—*This hindrance in the flow is very apparent at a time when the snow is on the ground. When a part of a valley is wooded, the snows that fall there lie much longer than in other parts, and while diluvial rains, which ordinarily cause inundations, would be quickly followed by a rise of waters in the cleared region, and suddenly augment the liquid mass in that portion, the same rains would affect but slowly the snows that lie in the wooded portions. The swell would come by slow degrees, and the flood would give no special cause of alarm.

*"Mountain Torrents:—*But it is especially upon mountains formed of slaty or marly rock that the utility of forests is shown in a remarkable degree. When the slopes of these lands, which have but slight powers of resistance, are denuded, the rains wear them into ravines with the greatest facility, forming partial excavations which extend from below upward, and end by forming a vast ravine, into which the lateral rills enter and which are themselves ramified in every direction. At every shower the waters plunge from every part of the mountain into the channels they have worn, producing a torrent that brings down with it masses of rock and scatters them over the plains. When the slopes are wooded, nothing of this kind can happen, for the trees protect the soil from the shock of the flood and by retaining it with their roots they guard it against erosions. They, moreover, break up the waters and hinder them from flowing too rapidly toward the valley, and thus, by this double effect, they oppose an invincible obstacle to the formation of these devastating torrents. The most effectual obstacle that can be opposed to these inundations is, therefore, reforestation, and of all preventive measures this is the cheapest, besides offering, above all others, the inestimable advantage of maintaining and of multiplying itself. We need not think that these effects will require a long time to be felt, for it is not necessary to wait until the woods have come to their full size, and in four or five years their effects will begin to be observed. Every replanting on these slopes

or plateaux is, in some degree, a conquest over the dominion of the floods, and a reduction of the ravages that they may commit.

*“Forests in Excess :—*But, carried to too great an extent, this operation will work precisely against the end which we desire to obtain. If the forests cover too great an extent of country, we may fear that the springs or subterranean water-courses may not be able to deliver all the rain that falls in a given time before other rains fall, which will cover the country with stagnant water. This was the condition of Gaul at the time when it was covered with forests, and such is still the condition of certain parts of America, which are wooded in this excessive degree. By this means we explain the apparent contradictions of which the partisans of reforestation are accused.

*“Reforestation where Needed :—*It will be necessary, before coming to the desirable conclusion as to where the true proportion lies, and which cannot now be known with precision, that we should be able to show for each river-basin how much of a reservoir a forest should furnish that shall discharge, freely and with regularity, the rains that it receives only at intervals. However the case may be, it is evident that the reforestation should be carried on upon the mountainous parts of the different basins. It is there, practically, that the humid winds condense the vapours that they contain, on account of the lower temperature which there prevails, and from thence comes the superficial flow of waters, the absorption of which we wish to increase, and make to appear in the springs, whose number and volume we would regulate. It is from thence, in short, the torrents begin, which become the forerunners of the inundations, which it is our wish, if possible, to control.

*“Certain Changes Beyond our Control :—*It may be asked as to whether, these investigations being ended, ‘shall we always be able to guard against these inundations?’ Probably not ; for it is not in the power of man to prevent atmospheric perturbation, and we have never yet found the remedies against the return at times of the warm and humid currents of air from the Atlantic, to which the diluvial rains are due which cause these damages. But at least, if we do not by reforestation entirely allay these evils, we may, peradventure, considerably reduce their magnitude, and enhance the efficacy of other means of defence which have until now been held as quite illusory.

*“Dikes and other Structures :—*At the present time most of the works constructed for the preventing of these evils, in fact, only increase them. It is held by a great number of engineers, that transverse dikes, in order to be of service, should be built in the lower parts of the valleys and near the mouths of affluents ; but the first result of this would be to cause inundations in these parts which are usually fertile and well-cultivated, and where, if they had not been built, they might not have been felt. We might have to pay damages for the property injured, and the sums, although considerable, would not always be compensated for by the advantages claimed. This system, moreover, amounts only to transferring the evil to another place, without escaping it, and it is at best but a secondary, not a radical, remedy. As for longitudinal dikes, not only are they frequently unable to withstand, in time of flood, the power of the waters, but they tend to erode the river bed, and to create obstacles which stop the materials carried down. Rivers, therefore, become for the country which they traverse a permanent source of danger, for, by a moderate flood the plains are often overflowed. Reforestation quite removes this peril, and by hindering the erosion of torrents they check the wearing out of the channels of the rivers and the obstructions at their mouths from accumulations of sand and gravel. They also tend to favour the construction of longitudinal dikes, at points where their utility is recognized.

*“Denuding Power of Rains :—*In the torrid zone the degradation of land is generally very rapid, but the waste is by no means proportioned to the superior quantity of rain, or the suddenness of its fall, the transporting power of water being counteracted by a greater luxuriance of vegetation. A geologist, who is no stranger to tropical countries, observes

that the softer rocks would speedily be washed away in such regions if the numerous roots of plants were not matted together in such a manner as to produce considerable resistance to the destructive power of the rains. The parasitical or creeping plants also entwine in every possible direction, so as to render the forests nearly impervious, and the trees possess forms and leaves best calculated to shoot off the heavy rains, which, when they have thus been broken in their fall, are quickly absorbed by the ground beneath, or when thrown into the drainage-depressions give rise to furious torrents."

An eminent English writer says :—

"When plantations and strips of wood of considerable extent are so arranged as to obstruct the wind in its course, shelter is afforded both to cultivated and pasture land, and in appearance as well as in productiveness the character of the estate undergoes a thorough change.

"It cannot be doubted by any one acquainted with the losses which are frequently sustained on high-lying farms from nipping frosts and withering winds, that in cold, late districts, shelter is of the greatest value to the farmer. Various kinds of crops are liable at the time of flowering to be seriously injured if exposed to strong winds, and frequently cereal crops, which are just beginning to ripen, suddenly assume a premature whiteness after being loosened about the roots by severe wind storms ; the crop is imperfectly developed and the farmer is the loser. Shelter will, to a very large extent, prevent this evil. Then, at harvest, it has been found that a line of plantations running transverse to the wind, though at a distance of half-a-mile, has materially diminished the loss from shedding. Along the eastern coast of Great Britain, a proper increase of shelter would not fail to add several bushels of grain to the yield per acre ; and in Caithness and Orkney, where, simply from the want of shelter at first, ordinary timber trees rarely ever become more than stunted bushes, the increase would be a great deal more.

"The only way in which either forest or hedge plants can be started into growth in these northern countries is to afford them at once the shelter of a stone wall or earth embankment, and often when their tops appear above the upper surface of the protecting dike, they are cut over by the winds as by a knife. This shows in its extreme aspect the importance of that shelter which, in all exposed situations, must in a greater or less degree promote the development of crops.

"The value of shelter for pasture stock is no less deserving of careful consideration. It is well known to veterinary practitioners that cattle grazing in high and exposed situations are generally more predisposed to consumptive and cutaneous diseases than animals pastured on low and sheltered farms. In cold, backward springs, the shelter conferred even by a very small plantation is to the sheep-farmer in the highland districts of the greatest practical service. On grazings much exposed to withering winds the large number of lambs deserted by their mothers in late seasons, in consequence of a scarcity of milk, is sometimes a severe loss to the flock-master. But it is well known that on the hill farms partially sheltered by growing timber, the percentage of deaths from this cause is considerably reduced. The pasturage, when sheltered even in a very partial manner, is both earlier and more nutritive than if exposed to the full effects of unchecked winds, and in their haunts, flocks rarely fail to indicate the situations which are really benefited by plantations, either near at hand or at a considerable distance. It is a well-known principle of animal nutrition that the radiation of heat from the system is greater in a cold than in a warm temperature, and that more food is necessary in the former situation than in the latter to maintain vital heat. If it is practicable, therefore, in the formation of plantations to elevate the mean temperature of any particular district two or three degrees, it follows that its grazing will not only be improved, but that, in proportion consumed, fattening animals will make greater progress than under less favourable circumstances.

"It appears conclusive, therefore, that the relation that exists between forestry and agriculture is a very intimate one ; and yet while great exertions are being made to develop the agricultural resources of the country, the inactivity which has long prevailed in respect to the management of timber continues the same, and presents, in some respects, an aspect hopeless enough."

Enhanced Value of Farms from Tree-planting :—In almost every instance in which a farm is to be let on lease the offerers are influenced, in a greater degree than they themselves are aware of, by the first general appearance which it presents. If the exposed parts are partially under thriving, well-enclosed wood, the whole fields, within the range of vision, have such a look of warmth and fertility that, as if by intuition, a few shillings more per acre are put upon the land than would otherwise have been given. The amenity and value of landed property are so linked together, that in ordinary cases the one cannot be increased without a greater or less addition being made to the other also. It has been proved by experience that in proportion as well-laid-out plantations are extended on an estate, up to but not beyond a certain point, the yearly value of its farms advance. I know property, which, eighty years ago, did not yield more than half the rental derived from it now. It was then, according to the testimony of old men in the district, little more than an open waste; but the proprietor began about then to plant extensively, and as the plantations increased in number and age, the rental of the estate advanced with them, though the farm was anything but good. With right management the same result may be expected on every exposed property."

The following article upon the forests of Europe and America is from J. G. Lefebvre (du Havre) who has long been intimately acquainted with the practical details of the timber trade in France :—

"One of the most important questions that presents itself to the attention of the principal producing and consuming countries in the article of wood, is beyond doubt that which relates to forests.

"It is an unfortunate fact, and becoming more and more true, that the clearing of woodlands is encouraged, and we may say, stimulated by the formidable and continually-increasing general consumption, which leads to proportions vastly exceeding the normal annual production, as we shall presently show. There evidently results a most threatening danger, which has already been often pointed out with energy, and against which the general welfare requires us to adopt on every side the most effectual and decisive measures, which should be executed with activity and perseverance, if we would seasonably avoid the consequence of a lamentable crisis.

"Taking a general review of the immense areas of ground, which various statistical works admit to be still covered with forests, it might at first sight appear that our fears were taxed by groundless apprehensions of exaggerated evils; but we feel assured that, considering the innumerable quantities of trees cut every year, the number prematurely destroyed, and the number wasted, it must be admitted that we should lose no time in trying to remedy, as speedily as possible, a condition of affairs so much to be deplored.

"We ought not to forget that in addition to the economical value of the forests, taken as a part of the wealth of the country, and in the welfare of its inhabitants, their protection in a climatic relation becomes a necessity of the first importance. No one is so ignorant as not to know that the inconsiderate destruction of trees reduces the water-courses, and causes disastrous inundations. We believe that the multiplied benefits derived from the presence of forests are not enough appreciated, such as the sanitary improvement of marshy places, the moderation of the temperature, the protection of open plains against violent winds which have their force broken and their currents divided by the trees; and, finally, the prevention of prolonged droughts, which too often desolate regions of country where the wood has been taken off, as has been frequently proved by examples down to the present time.

"We should also not fail to remark that we often find tracts of land masked by a thick covering of verdure, that are in reality nothing but immense wastes occasioned by fires or storms, and which contain little but the wrecks and remnants of trees, and are sometimes overrun with wood insects, some species of which in a little while may destroy whole forests, as was lately seen in Bohemia, where a million of cubic toises of wood were entirely destroyed.

"If we now approach the question of production and consumption in the principal countries of Europe that are now occupying our attention, we shall find conditions of a

nature to convince the most incredulous as to the duty of the state foresters to seek without further delay for such remedies as the situation demands, so great is the actual peril."

A most valuable paper bearing on this point was read at the Cincinnati Congress, by the Hon. V. Colvin, Superintendent N. Y. S. Adirondack Survey. I wrote to Washington for this paper, but it was not in print. I can therefore only give my readers the abstract given by the Forestry Congress Commissioners sent from Ontario:—

"The influence of forests upon the water supply of any given drainage area is directly proportional to the rainfall, and it is from the standpoint of evaporation and rainfall that the effect of forests must be considered.

"The data for the investigation must be searched for in the east, where the destruction of forests has been great. Here, rather than on the frontiers of civilization, we should look for traces of climatic change, if the destruction of forests lead to any change.

"The records of the United States Signal Service of the mean monthly precipitation in this country for many years had been searched by the lecturer for statistical information on this subject, and he had based upon these records a series of computations which showed where the greatest irregularities in the monthly rainfall occurred.

"These differences were presented in tabular form, and showed a favourable uniform monthly precipitation of rain in the middle Eastern States. Here it is known that the approximate limit of safety of forest-cutting has been reached, as torrential action began to show itself in sections where much timber had been cut away.

"The topography of the country was shown to have a most important bearing upon the quantity effect of forests upon the rainfall; the mountain ranges, when forest-covered and extending across the path of the south winds, acting as powerful condensers of moisture. The way in which limbs of trees entangle and kill the wind, to which a house or block of houses forms hardly any obstacle, was explained in an interesting manner, and was shown to be dependent on the angle of incidence.

"The true relationship of atmospheric electricity to rainfall was traced through the reactions of the correlated force, so often incorrectly termed "latent heat." The limbs, boughs and leaves of the forest were (when considered mechanically) natural machinery most wonderfully adapted to the purpose of grasping upon the atmosphere, and thus causing those dynamic changes which induce precipitation of moisture.

"The forests were, in fact, most singularly complicated condensers, and performed their peculiar office in the atmosphere far better than the most skilfully contrived alembic of the chemist.

"Forests were shown to be essential to a uniform rainfall when existing in the proper localities, as determined by the great local meteorological laws.

"A knowledge of the path of storms in any locality, and of the topography—the elevations and depressions, the rivers, marshes and lakes—was shown to be essential to any exact estimate of the limit of safety of the cutting of forests. The only way in which the wide-spread knowledge necessary could be obtained would be by a general system of observation by farmers and others throughout the whole country, of the great facts of the local rainfall, direction of winds, etc., which could be easily done with little trouble.

"With these observations, and an accurate system of topographical and forest maps (which every State should have made), it would be possible to make close estimates as to where forests must be preserved, where replanted and where they might be safely cut. The lecturer told of his personal experiences on the mountain peaks of the Adirondacks and the Rocky Mountains, traced the origin of rain from its evaporation by the sun's rays from the sea to its condensation to cloud—and showed how Bui Ballot's law readily enabled meteorologists knowing the path of storms, from a mere knowledge of the present direction of the wind and the area of the last high or low pressure, to determine the probable maximum or minimum liable to follow, and probable change in the direction of the winds; but that the location of forests greatly modified the exact application of

this law, and rendered imperative that we should study the path of storms on exact topographical maps giving the location of forests, and that then only should we be able to make exact predictions."

THE FORESTS AND THEIR MANAGEMENT IN OTHER COUNTRIES.

To obtain knowledge on this head, no better source of instruction is available than the extensive report made on the subject by Captain Walker, a gentleman who passed nine months on the continent, by direction of the European Government, for that purpose. I cannot copy his voluminous report, but will give a short review of what refers to each country visited, and anything likely to be useful for our purposes here in Canada. The Captain first visits Hanover, describing the system in which territory to some extent describes all, for he tells us that the system there may be considered as typical. He gives then, the administration there, and a brief statistical record of the others, except in those points where they decidedly differ. Now, as to Hanover.

HANOVER.

Its forests under State management amount to 900,000 acres. Some are Government, some Church, some belong to municipalities or communes. Government manages the forests by officers appointed, while the community pay four cents per acre towards the pay of the officers. The method appears to be that of giving the owners as much wood, pasture, or litter for manure, as their original right to the forest entitled them to; but to give it at the hands of government officials. If the forest is of sufficient extent to employ a special officer, the commune, instead of the four cents, are charged his pay and allowances, as well as other working charges.

The government forests are about 600,000 acres of the above, and the cost of working and all expenses is about \$650,000 annually, the receipts being \$1,500,000, and the profit therefore \$850,000, or, taking the actual figures, about \$1.50 per acre per annum. This, of course, takes no account of the value of the land, or what it might rent or sell for if cleared.

Hanover is a province of Prussia. The head office is therefore in Berlin. The Forest establishment of Hanover consist of one forest director and over-forest master, who is also a councillor; twenty forest masters in charge of circles or divisions, forming also a board of management in all forest matters; one hundred and twelve over-foresters in charge of forest districts (*revier*) averaging seven or eight thousand acres each; four hundred and three foresters who assist the over-foresters, and have charge of portions of a district; three hundred and forty-three overseers, under-foresters, etc., employed in watching and protecting the forest, and supervising the work which is executed by hired weekly or daily labour, or on contract under supervision of the fixed establishments. A cash-keeper is attached to each over-forester, who receives and disburses all moneys out of the forest cash chest, with which the over-forester has nothing to do, although his accounts should, of course, tally with those of the cash-keeper. For payment of labourers etc., he gives orders on the cash-keeper, whose books are examined by the forest-master

in charge of the division, and accounts rendered to the head office in Hanover, and thence to Berlin.

All the forests have been surveyed, valued, and divided into blocks in this manner :—

Besides those already enumerated, there is, for the sole purpose of measuring, valuing, and framing working plans for the forest, a superintendent, draughtsmen, and clerks, generally practical foresters, and a staff of surveyors and forest valuator, who are generally candidates for the position of over-forester.

When a forest was about to be taken in hand and worked systematically, a surveyor and valuator were despatched to the spot, the former working under the directions of the latter, who placed himself in communication with the local forest officer and the inhabitants interested, and obtained from them all the information in his power. The surveyor first surveyed the whole district, then the different divisions, as pointed out by the valuator, who defined them according to the description of the timber standing, and any conditions affecting the nature of the trees to be grown in future. While the surveyor did this, the valuator valued the trees, formed a register of rights with a view to commutation, considered the best plan of working the forest, the roads, in fact, all which enabled him to form a plan for the head office, and a subordinate plan to be handed over to the executive officer as his “standing orders.”

The valuator and surveyor return to head-quarters, and prepare the maps and plans, which are submitted to the board of forest-masters, the forest-director and other councillors of the Finance Department, who are thus prepared to listen to any objections made by communities or individuals, which are very rarely made now, as the people have learned that the action of the officers is not adverse to their interests, and are willing to allow them to settle matters.

The executive officer has thus in his hands maps showing each division of the forest tract in his charge, and instructions—the quantity to be felled yearly, the extent to be planted, the state in which the forest should be ten, twenty or a hundred years after the plans were made, all calculated—so that the over-forester has only to carry out the instructions given him, allowance being made for unavoidable difficulties—failure of seed, occurrence of storms, and the like.

The forest-masters have no executive work, but control four to six over-foresters, of whose labours they make frequent reports to the Director (both in forest and office work). The over-foresters give annual reports of operations. They spend most of their time in the forest, supervising the felling, planting, sowing, thinning, carting and selling of timber. The laying down of roads is done by a forest officer, but the actual work is carried out by the local officer, who has also much office work, giving grazing licenses, etc., and preparations of returns, but his work is out of doors compared to that of the forest-master, who has more office work : comparing operations and rates in the districts, collecting statistics, settling disputes, and as a member of the forest committee, revising working plans.

The main object aimed at in any scientific forestry is, to convert the natural forest, consisting of trees, young and old, good and bad, too thick and too thin, into blocks of trees of the better description, of the same age, and capable of being worked—that is, thinned out, felled, and reproduced, or replanted, in succession, a block being taken in

hand each year. In carrying out such a system, considerations must be attended to, such as the relation of the block to the whole forest system ; the needs of the people in timber, firewood, leaves for manure and pasturage ; the soil, the situation as regards winds (which must be attended to in felling to lessen damage), and precautions against insects, fire, trespass or theft.

The plans need revising every twenty years, though it is marvellous to notice to what an extent the original scheme has generally answered.

After a forest has (to give some idea of management) by thinning, planting, and so forth, been gradually got into perfect order as described, the system of natural reproduction forms great part of the German method. It is as follows :—

The rotation and periods are fixed in the working plan. For beech “hochwald” it is in Hanover one hundred and twenty years, divided into six periods of twenty years each, that is to say, when the forest has been brought into order there should be nearly equal areas under crop of trees in each of the six periods, that is, from one year to twenty ; from twenty years to forty, and so on. When a block arrives in the last period, felling is commenced by what is called a preparatory clearing, followed by a “clearing for light” in the first year after seed has fallen (the beech seeds every fourth or fifth year) with the object of—1st, preparing the ground for the seed ; 2nd, allowing it to germinate ; 3rd, affording light to the young seedlings. If there is a good seed-year and sufficient rain, the ground should be covered with seedlings in two or three years after the first clearing ; but it is better generally to wait for a second seed year, and aid nature by hand-sowing, transplanting from patches of many to the barer spots, and turning up the turf to give the seeds a better chance of germinating.

When the ground is well covered the old trees are felled and carefully removed, so as to do as little damage as possible to the new crop, and the block recommences life, so to speak, nothing further being done till the first thinning. The time allowed between the first and final clearings is from eight to fifteen years. But in many provinces they do away with this system, and remove the old trees so gradually that there can hardly be said to be any clearing at all, the new crop of trees being well advanced before the last of the old trees is removed.

In these forests can be seen all the periods of growth—nurseries and schools for seedlings, which are transferred thither, at the age of two to four years, from the seed-beds, and are pruned and transplanted as often as seems required till finally planted out, sometimes not till twelve or fourteen years old. There are many methods of planting adopted here. The steepest and most rocky sides of the hills are covered with forests, which have been created by the labours of the Forest Department. In many such places, where even the few handfuls of soil placed round the young tree had to be carried some distance, it is not contended that the first plantations will yield a pecuniary profit, but the improvement in climate by the retention of the moisture, and reclamation of large tracts formerly barren and unproductive, is taken into account ; besides which the dropping of leaves and needles from the trees will ere long create a soil and vegetation, and insure the success of plantations in future years, and consequent surplus.

PRUSSIA.

Prussia has twenty millions of acres of forests, ten millions of which are private, and the remainder, with which we have more to do, state, commercial, and ecclesiastical.

Of these the income is \$14,000,000, and the expenses \$7,500,000, leaving \$6,500,000 clear. This will not show much, in fact not more than 65c. per acre, but there are other returns of more than mere yearly revenue importance. When it is considered that this result is arrived at without trenching on the capital or stock of timber in the forests, which, on the contrary, is being increased and improved in every province of the kingdom; and that the indirect value to the people of many forest privileges, which they exercise free of charge, must be very great, not to mention the benefit to all in the shape of public recreation grounds and an improved climate, some idea may be arrived at of the enormous value and benefit such a system of state forests must confer on Prussia.

The forests, as already stated concerning Hanover, form part of the finance department, and are presided over by an overland-forest-master, and ministerial director, aided by a revenue councillor and joint ministerial director, and a numerous council or board.

There are two forest academies, one near Berlin and one in Hanover. The overland-forest-master is curator of the academies, and at the head of each is an over-forest-master, who is aided by a numerous staff of professors and assistant-professors.

There are twelve provinces in Prussia, divided into thirty circles, and to each an over-forest-master, who is appointed to represent the forest department in the council of local administration, and is aided by councillors and by the forest masters as a board, to represent forest interests in the government. Next in order come the forest-masters, numbering one hundred and eight, in charge of divisions with an average area of sixty thousand acres, and then the executive officers, seven hundred and six over-foresters, to each of whom is 7,000 acres, and to each of whom is attached a cash-keeper, and three thousand six hundred and forty-six foresters, or overseers, with ranges of a thousand to three thousand acres.

At the academy near Berlin are seven professors with assistants. There is an experimental garden attached, with an over-forester in charge of the technical portion, and professors for the meteorological, zoological, and chemical sections. The number of students averages sixty-five. The varied apparatus includes a building where the seed is dried and separated from the cones, large seed-beds of spruce, fir, and willow, full opportunities of transplanting seedlings, and examples of every kind of trees for botanical study.

There is here a museum, rich in specimens of all sorts of birds, animals, and insects found in the forests. In cases where the animal or insect does damage to trees, specimens of the branch, bark, leaf, or cone, in a healthy state, and after being attacked, are exhibited close to each, so that the students can see at a glance the nature of the damage, and connect it with the animal which causes it. Thus we have squirrels, rats, beavers, mice, set up gnawing the barks, grubbing at the roots, etc. Insects are shown in the several stages of their existence—larvæ, chrysalis, caterpillar, moth, with their ramifications in the stem or branches of the tree. These, with specimen blocks of almost all descriptions of timber, form a most instructive collection. There is a forest district

attached, remarkable for the growth of Scotch fir and spruce on a poor sandy soil, and in spite of repeated attacks by insects.

Nothing is more remarkable than the extent of study required from forest candidates, and the number of years they are content to spend in studying or waiting an appointment. The would-be over-forester, which is the lowest of the gazetted appointments, must pass certain terms at a Government school, a year in a district with an over-forester, an examination as forest-pupil, two years at a forest academy, an examination in scientific forestry and land surveying. He is then a forest-candidate. Then two years practical study, nine months of it doing duty as an actual forester; then another examination. He is now an over-forester candidate. The first examination tests his theory; the second his practice. Then he will be occasionally employed in the academies, or in charge of a district, only then getting allowances. After five years of this he may look for steady employment.

Thus five years without pay are given in study; five in probation with but meagre pay when employed, and the time is often longer, before regularly installed. Yet so great is the desire for Government—especially forest—service, that there are numerous candidates.

The qualifications for admission into the subordinate grades—forester, sub-forester, overseer—have a military tendency. Candidates, after two years in the forest, enter a jager battalion, and bind themselves for twelve years' service. After three years they obtain leave, and are employed in the forest as huntsmen or gamekeepers. After eight years they must have passed the forester's test, which consists in six months' charge of a district, and an examination. At the end of twelve years they are discharged with a certificate entitling them to employment in the forest establishments. The appointments are much sought after, and in 1867 there were two hundred and twenty-one applicants for one hundred and forty-five vacancies; but many are absorbed by communal and private forests.

In some provinces the Prussian Government has certain rights concerning the management of even private forests—in others none.

While on the subject of Prussia, it may be well here to insert some extracts from a letter received from Baron Von Steuben, a Prussian nobleman, now Royal Chief Forester of the German Empire, by the Forestry Congress, at Cincinnati, in April of last year. He remarks:—

“There can be no doubt that every country requires a certain quantity of well-stocked woods, not only to supply the demands for building material and fuel, but more especially to secure suitable meteorological conditions, to preserve the fertility of the soil, and out of sanitary considerations. The ratio of the minimum quantity and judicious local distribution of the indispensable forest to the aggregate area cannot be expressed by a universal rule, but the same can only be approximated by scientific investigation. Above all things, it is essential to prevent forest destruction where such would injuriously affect the fertility of the soil. It is important, then, to preserve and to cultivate judiciously those forests which stand at the head-waters and on the banks of the larger streams, because, through their indiscriminate destruction, fluctuations in the stage of water, sand-bars, and inundations of arable lands are occasioned. It appears also necessary to preserve and properly to cultivate woods in quicksands, or the summits and ridges, as well as on the steep sides of mountains, along the sea coasts, and other exposed localities.

"In Germany, and especially in my more narrow-bounded Fatherland, Prussia, it is regarded as of the greatest importance, not only to preserve the forests already there, but to extend them as much as possible.

"In the National Appropriation Bill large sums are set apart for the purchase of such lands as are unfit for cultivation, and for utilizing the same by planting trees.

"With reference to forests owned by private individuals, they are not restrained in the use of their forests, and may, according to their own judgment, clear the same and till the soil, in short, do what they like, and yet there may be certain restrictions placed on the free use of the same as soon as danger to the common welfare is feared; these restrictions are prescribed by the law of July 5, 1875, relative to forest protection.

"This law is applicable in cases :

"1. Where, by reason of the sandy nature of the soil, adjoining lands, or public grounds, natural or artificial courses, are in danger of being covered with sand.

"2. Where, through the washing away of the soil, or through the formation of cascades in open places on the ridges of hill and on hillsides, the arable lands, streets, or buildings living below are in danger of being covered with earth or stone, or of being flooded; or the lands or public grounds, or buildings lying above are in danger of sliding.

"3. Where, through the destruction of the forests along the banks of canals or natural streams, riparian lands are in danger of caving, or buildings hitherto protected by the woods are in danger of iceflows.

"4. Where, through the destruction of forests, rivers are in danger of a diminution of the stage of the water.

"5. Where, through the destruction of forests in open places and near the lakes, neighbouring fields are seriously exposed to the detrimental influences of winds.

"In the cases above mentioned, which have been copied verbatim from the statute book, the manner of use as well as the culture of forests may be legally ordered, in order to prevent those dangers where the dangers to be averted are considerably in excess of the damages which would result to the owner by reason of the restrictions."

SAXONY.

The state forests are nearly 400,000 acres, worked at an expense of \$500,000, receiving \$1,750,000, leaving a clear rental of \$3 per acre. The expenditure is planting, draining, roads, improvement of inferior woods, felling, transport, killing insects, etc. About 5,000 acres are planted yearly, at an average cost of \$7.50 per acre.

The fixed establishment is one inspector, fifteen over-forest-masters, one hundred and twenty district foresters, sixteen cash-keepers, thirteen engineers, twenty-seven foresters, and eighty-three sub-foresters.

There is a forest academy at Tharandt, with a separate staff of professors.

The system of planting now principally experimented on is much the same as that previously described, the young trees being several feet high before the old trees are all removed. One operation is noticeable. It was decided to convert a mixed hardwood forest, patchy and irregular, with impoverished soil, in 1820, into a coniferous forest, and maps were drawn showing what it would be in eighty years. Private intersecting lands have been bought up, and by 1900 the ideal chart will be actual. Already, in place of a straggling wood, irregularly covered with timber trees of inferior growth, we have now a compact close forest, regularly wooded in sections of different ages, principally spruce and Scotch fir, but containing also fine oak, ash and beech, with straight and clean stems. In many cases the young oaks have been left where pines were planted, and the introduction of the latter has had a wonderfully good effect on the oaks.

All private rights were abolished and compensated in these forests by a Bill passed in 1832.

BAVARIA.

The state forests are 3,000,000 acres. They return, after paying all expenses, about \$1.50 per acre per annum. About 30,000 acres are planted or sown annually, taking 35,000,000 plants and 1,000,000 lbs. seed. Persons found guilty of breach of forest rules have been punished by enforced labour in the woods. Private forest rights are being bought up by the Government.

The system of management is much the same as that previously described. There is a forest academy at Aschaffenburg, with one hundred and sixty-five students.

It will be interesting to notice the injury and process of repair in the fine forests of the Spessart in Bavaria. The deterioration was caused by felling the forest trees as soon as, or before, they were mature, the impoverishment of the soil by the removal of leaves and litter, and the allowing dense underwood to grow unchecked. Inferior trees got the upper hand and prevented the growth of good, while they drained the already impoverished soil and gave nothing in return. Early in the present century the matter attracted attention, and every means have since been adopted to grow oaks, beech, and coniferæ. The result is, though not yet equal to the uniformity of other forests, nowhere can one find finer clumps and individual trees. Inferior trees will soon be rare in the whole forest. In remote portions where the humus had not been destroyed, the growth of beech and oak is truly magnificent, tracts of 120-year old beech and 300-year old oaks being common, the latter with clear trunks running up to a hundred feet high. When we compare these with other portions where the crippled and stunted appearance of the trees shows the effect of unregulated grazing and loss of litter, burning of the decayed wood, and forest theft and mischief, or the soil and vegetation, the result is marked. The circumstances, says the Indian Commissioner, are analogous with what has gone on in India for centuries, and is still more or less permitted. The vast extent of forests, which once clothed the hill sides and extended far out on the plains, and the luxuriant growth of the tropics, have hitherto, or until the last two years, prevented the gradual deterioration of our forests being marked or felt, but the subject has now attracted attention, and none too soon. If any have doubts in the matter, let them visit the Spessart, study the history of its forests and judge for themselves.

The forests are sharply protected by law, the average number of prosecutions annually being thirty per thousand acres. The crimes are mischief to wood, pasture, grass, straw, and miscellaneous.

AUSTRIA.

Scientific forestry is not so far advanced as in Germany, but officials are busily introducing a reorganization, by means of which, there is no doubt, it will soon be on a par with other states.

The state forests have been largely sold to meet state necessities, but there still remain nearly 2,000,000 productive acres, which yield, however, after expenses are paid, little over twenty-five cents per acre.

The existing establishments of forestry are not uniform, but there are about twelve hundred employés, of whom twenty-two are forest-masters. Some of these have almost

sinecures, while others have six times too much to do, and it is the same with those in the subordinate ranks. The forest academy is at Mariabrunn, near Vienna. There are about thirty-five students.

The collections are fine, possessing specimens of all instruments and appliances made use of in felling, squaring, sawing, carting, and preparing timber, models of sawmills and machinery of all descriptions, plans of river beds improved and embanked for floating, sluices of all sorts, dams and piers for directing rafts in their course and catching firewood, models of rafts, and specimens of home and foreign timber of all kinds. The damage done by animals and insects is also exhibited here comprehensively. There is also a forest garden attached to the academy for the instruction of the students.

The staff of the academy consists of the director, thirteen professors and assistant professors, with subordinates in the account office, laboratory, etc. There is also a forest school at Bruhl, for training young men (of whom eight were there) as practical foresters.

The greater number of those trained here are intended for private and not for Government service, their expenses for board and lodging being paid by noblemen and large proprietors, from whose estates they come, and to whom they return as forest officers and workmen. The state maintains the schools, and pays the professors' salaries, and there are no extra fees. This cannot fail to assist the intelligent management of the private forests of the empire, which are very extensive. The absence of numerous candidates for the government forest service, and preference for private employment is noteworthy, when compared with the opposite state of things in Prussia. The irregular promotion, lack of system, and low salaries in the Austrian forest service are the explanation.

The Austrian crown forests have been neglected; they are patchy with a low and decreasing yield per acre. There has been till now no attempt at rotation of blocks, or working in periods. As is found in India, a glance at the outskirts of the forests would lead one to suppose it fairly stocked with timber, but a more careful inspection proves that this is not the case, and that only in the valleys and more remote portions, where the soil is particularly good and the axe has not been so frequent in its inroads, is there a fair and regular crop.

Herr Schuppitch, the present director, is trying hard to change matters, and is changing the hardwood crop, which has exhausted the soil for that class, with pine growths, which besides grow quicker and pay better. He is also dividing into blocks and periods, and planting up many bare or ill-covered tracts, where natural reproduction is impossible owing to the absence of standard trees.

GRAND DUCHY OF BADEN.

We shall now notice a private forest, that of the Prince of Furstenburgh, in the Black Forest. The receipts and expenditure are not obtainable, as are the public ones, but we are informed that the forests are economically worked, and that the liberal sums expended on road-making, fitting rivers for floating, housing foresters, &c., were well repaid by the facilities secured, and contentment and zeal of the employés. In the case of this, as of other private forests, it is evident that a private individual is not burdened with considerations of policy and public good as in a State. The forests are, therefore, worked with the best profit compatible with their retention as capital.

There are about 72,000 acres, in charge of eighteen foresters and over-foresters, who of course have many subordinates. The method employed is the slow felling and continual reproduction before mentioned, a block being after forty years in clearing before all the old are replaced by new trees. Attention and intelligence are necessary, for the seed will not grow nor the seedlings flourish without enough light, and the forest officer must watch that they get it; and again much greater care is needed in felling and hauling away when the trees are surrounded by lofty saplings and young trees than when the seedlings of the next crop are not more than a foot or two high. In this the axe-men of the Black Forest are adepts, and the damage very slight to what it would be in other hands.

It may be useful to describe their manner of bringing timber down the rivers. It cannot here be done when the stream is in flood; in fact, the less water in it the better so long as sufficient is stored up above to float the rafts. Reservoirs are made, and the water poured into the river bed when the raft is ready. The streams are often small, of only fifteen or twenty feet in width, and have to be prepared for floating, by being cleared of any large rocks or boulders, and "sleepered," if we may use the expression, by pieces of wood firmly fixed in the bed of the stream every few yards. These prevent the formation of holes in the bed, and serve for the raft to slide on if it touches the bottom. The first impression of the Indian commissioner, when he saw the float, composed of stems from twenty to sixty feet in length tied together with withes at the ends, and lying zigzag in the bed of a mountain stream, up and down which they extended sixteen hundred feet, was that it was simply impossible they ever could be floated down the stream, with all its windings, and over the locks and rocks which occurred pretty frequently. It contained 880 stems, eight or ten of which abreast formed as it were a link in the raft. There were thirty links, not fastened laterally, but only at both ends to the next link. The breadth is greatest at about two-thirds from the prow, which is narrow, and consist of only three stems abreast, with in front of all a piece formed of old wood and raised out of water like the bow of a whale-boat, so as to lead the raft, and the largest and heaviest stems placed in the broadest part and towards the stern or hinder part, which does not taper at all. There are two or three breaks, by which the speed is slackened or the raft stopped if needed. When all is ready, the water from above is let loose, and the raft, perhaps not now lying in more than a foot of water, begins to float a little, but is not let go till two-thirds of the water is passed, as it is a curious fact that when let go, if there is much descent, it travels faster than the water, and has to be stopped to let the water get ahead again. The raft has eight or ten men and boys, one or two of whom stand by the master at the chief break, on which the safety of all depends.

When let go it is exceedingly curious to see the forward part dart off at the rate of five miles an hour, and the several links which have been lying zigzag and perhaps high and dry uncoil themselves and follow in its wake till the whole dashes along at great speed and apparently uncontrolled. Accidents are rare, as they are well trained (lads of six or eight can be seen going down in miniature floats); but for one not accustomed to it, it is nearly impossible to stay on the raft at all, as it literally springs out of water on touching a rock, dashes round a rapid turn, or jumps a weir with a fall of several feet. Forty or fifty miles can be got over in a day if stoppages to let the water ahead are not too frequent or the stream is not swollen by rains.

REMARKS ON GERMANY.

The Indian commissioner proceeds to remark on the German system of forestry. Perhaps it will be here admissible that I make one myself. Let me say that, when we consider the immense extent and rapid growth of forests in India, the vast amount in Government hands, and yet find that they are so rapidly deteriorating as to necessitate the despatch of commissioners to Europe to learn the methods of preserving the forest, it is likely that Canada has just as much reason to bestir herself in the matter. Let us notice also, by some of the valuable tables Capt. Walker has furnished, that in Germany and Prussia alone there are nearly two hundred and fifty millions of acres of forests. We will well have already understood, by the foregoing pages, how different the great mass of these forests, with their great reserves of growing and well cared for trees, planned and prepared for many years, so that the forest can be depended on to give its regular and annual yield of valuable timber in perpetuity, are from our Canadian reserves, which are cut without regard to the future, and are fast disappearing before the combined assault of the settler and the lumberman.

On asking, where are we to look for a model or precedent on which to work, he replies "To Germany, where the management of forests by the State has been carried on for hundreds of years. Not the mere planting of a few hundred acres here, or reserving a few thousand acres there, but a general system of forest management, commencing by a careful survey, stock-taking, definition and commutation of all rights and servitudes, careful experiments in the rate of growth, the best soil for each description of tree; in fact, in every branch of the subject, and resulting in what we find to-day, hundreds of thousands of acres mapped, divided into periods and blocks, and worked to the best advantage both with regard to present and future, and the annual yield of which now, and for many years to come, is known and fixed to within a few hundred cubic feet."

"The great difference," says the commissioner, "in climate and local conditions between India and Germany would, doubtless, necessitate important modifications, but I can see no reason why the broad principles of organization and forest management should not be applied with success to our Indian forests, that is, gradually feeling our way as regards the best mode for the forest, and the wishes and interests of the people and the State."

I would here remark that this is still more applicable to Canada, as our climate presents no difference of moment.

"I do not think," he continues, "that we have much to learn from the Germans with regard to the planting and rearing of young trees; but it is with regard to the best method of managing groups or plantations that I consider we may, with advantage, take a leaf out of their book. For instance, I would certainly introduce, in an experimental manner, and on a very small scale, their system of rotation, clearing, and periods, and endeavour to bring forward a second crop before the first is off the ground, encourage the growth of the better descriptions, and keep down the least valuable, so as gradually to arrive at groups of trees of the same age, description, and class, and eventually at blocks worked in rotation, and containing always a sufficient stock of crop coming on to meet the requirements of future years. To arrive at all this the most careful observations and experiments will have to be made as to the rate of growth and yield per acre of each description of forest, the conditions under which trees grow best and form the most timber, some requiring close and some open planting, some nurses and some not; some, like the oak, requiring a great deal of light, while some, like the beech, do best for many years in the shade. All these points, and many more, demand attention, and till they are

settled we shall be merely groping in the dark. In fact, I think it may be taken for granted that all we will do in the way of forestry in the Madras Presidency, during the present century at least, will, after all, be but experimentalizing, which fact, however, need in no way delay the demarkation, survey, and settlement of the forests."

It may be said here that, if it be necessary to commence at once, in India, it is probably more necessary in Canada, where the process of growth is so much less rapid.

Concerning the capabilities of German foresters, the Captain says:—"An over-forester, and even many of the foresters and overseers, can tell the name, local and botanical, of any tree, shrub, and plant, classify it, and state its uses; name and classify every beetle and insect in the forest, and know whether they are harmless or destructive to trees, in what shape they do damage, and what are the best known preventive measures; inform you of the nature of the soil, and to what period the formation belongs; what trees will grow best, and why. All this is known thoroughly, theoretically and practically.

"Then as to the district, the exact yield, rate of growth, and annual increase in value of each block is thoroughly known and can be put down in figures at each moment by the over-forester, who can tell at the commencement of each year how much timber he is going to cut and sell, and from what parts of the forest it is to come, how many acres have to be partially cleared for natural reproduction, how many to be planted, sown, thinned, or planted up. The mere details of all this are left, as a rule, entirely to the subordinates, who thoroughly understand them.

"The forest-masters in charge of divisions possess not only the theoretical and scientific knowledge acquired in the forest academy, and the practical experience gained while they were over-foresters in charge of a district, but the more extended knowledge and wider views from their larger field for observation and comparison of causes and results. They are then qualified to decide most points, revise working plans, and supervise operations generally, whilst settling complaints and complications in connection with the forest administration, advising the local head of the department, and compiling valuable reports and statistical information."

THE BRITISH ISLES.

There are many forests, both Crown and private, in the British Islands, concerning which, as they appear to be managed on different systems, I shall merely state such points as seem to have some bearing on possible operations in Canada, or may show the progress made in late years in planting and foresting operations.

In the New Forest, Hampshire, containing 91,000 acres, much has been planted with Scotch fir and larch in 1853, and with oak in 1857. What is noticeable is that the first, planted as nurses, are planted here so much before the others (both are elsewhere frequently planted at once). It is done to establish the nurses, and give shelter from the cutting winds prevalent here. They transplant here from the first nursery to another—the last one near the ultimate destination of the trees.

The Dean Forest, in Gloucestershire, has 22,000 acres, in all. The commissioner visited twelve plantations here, ranging from 1844 to the present year. Nurses and hardwood are put out together.

In Scotland, the nurseries of Lawson & Sons, near Edinburgh, are noticed. They contain 270 acres. There were thirty millions of coniferæ seedlings in the beds. The *pinus pinaster* is largely used for planting on light sandy soils near the sea.

Before sowing or forming the nursery bed the land is trenched to fourteen inches, and a crop of potatoes taken off to clean it. In the following spring the seed beds are

laid out, and the upper soil carefully prepared to suit the nature of the trees which are to be sown. Most of the coniferæ prefer a light dry soil with a considerable proportion of sand, and this has the advantage that the seedlings are easily shaken out and freed from each other for transplanting. In the case of Scotch fir and larch, the seed is sown in May or June, and left in the seed bed for two seasons. The seedlings are then planted out in lines fourteen inches apart, and three inches between each plant, are left thus for sometimes two years, and then planted out for good. It is thought better, if the frost can be prevented from killing the seedlings, to sow in April, and transplant one year after, or even the same autumn, as soon as the leaf bud is hard. The spruce requires two years in the seed beds, as its growth is slower than that of larch. The *pinus pinaster*, *austriaca*, and *laricio* are sown in May or June, and transplanted the same autumn into rows six inches apart, the plants close together. Hence they are transplanted the following autumn, into rows fourteen inches apart, where they are left one or two years before being planted out. It is considered an object to shorten tap-roots and encourage laterals. (This last idea, it will be noticed, may assist the tree; but not that main object of forest preservation, the connection between the upper and lower strata.)

The Earl of Seafield's woods, in Strathspey, give an instance of the rapidity with which planting is going on in Scotland. There are 60,000 acres, of which half are in timber, yet so young, that the commissioner saw little large wood ready to cut, but plenty of thinnings. The overseer intends gradually to plant the whole, so that, in course of time, a thousand acres could be cut annually and a thousand planted out, which could not, it is said, fail to bring in a large revenue, without trenching on the capital of timber. Three lines of Scotch fir the commissioner saw lifted and tied in bundles for planting out. This was done expeditiously by the five-pronged fork, two men digging out the young trees, which are then lifted by women, the earth shaken off, and tied in bundles for planting. This list will give some idea of the progress on only one estate:—Duthil Hill, 700 acres, planted six years; Deshar, 1,100 acres, within seven years; Sluemore, 600 acres, five years; Revock, 700 acres, four years; Bengalupin, 1,200 acres, six years; Advie, 300 acres, one year.

A point here presents itself which, though it seems vague, and not according with Canadian experience, it might be well to examine and find the meaning of. The Strathspey overseer considers that "in Strathspey, at least, the land should be left barren and untouched, after it is cleared of trees, until the natural herbage, whether heather, grass or moss, which existed before the trees grew, recovers; and that if planted before this takes place, failure will result."

It may be remarked that oak is now little planted here, its use for ship-building being much less than formerly; while, even for backing for ironclads it is abandoned in favour of teak, which has not the injurious effect on the iron produced by the contact of oak. Scotch fir and larch are much planted, and are rapid in natural reproduction. Whenever the natural vegetation has sprung up in places formerly covered with coniferous trees, the seeds germinate. This is then protected by wire fences with great success. In a large tract of self-sown forest in the Grantown district, enclosed six years ago, the Scotch firs average six feet high, while individual trees run up to ten feet.

Wire fence, tarred, three feet eight inches high, can be constructed for seventeen

cents per yard, posts and all, and is much used. After ten years, or when the trees have grown out of harm's way, pasture is sometimes let. Enclosed plantations for this purpose command 2s. 6d. per acre, while ordinary hill side pasture gets but 6d.

The Earl of Mansfield's woods, in Perthshire. These are about 10,000 acres. Planting is going on constantly. There are nine district foresters, and a large staff of woodmen. A large plantation of Douglas pine is mentioned as doing remarkably well. They were planted in pits fifteen feet apart, fifteen inches square, and ten inches deep, with larch and Scotch fir nurses at four feet apart. The pines average twenty-five feet in height. The nurses are being removed. The overseer disagrees with the Strathspey statement as to leaving the land bare, and considers that it is only the insects (the beetle) which hinder the growth of seedlings on land cleared of conifers. He succeeds well by excluding cattle for one year, letting the grass, etc., grow, then burning it when dry, and planting out.

The Duke of Athol's woods, in Perthshire comprise 10,000 acres, and were commenced in 1728, principally with larch, which has done well in places, but is now undergoing the substitution of Scotch fir, which pays better. Oak coppice cut at intervals of twenty years yield \$60 per acre.

FORESTS OF LUSS AND THE HARZ.

Another gentleman, M. Gustav Mann, Conservator of Forests in Bengal, has proceeded to Germany for the same purpose as Capt. Walker, and gives some further important information relative to the German forests.

In the plain of North Germany the Scotch fir is the principal forest tree, and better suited for deep, loose, sandy, than for heavy loaming soil.

The great "Luneberg Heath" is mentioned, as having been covered with wood, but the indifference of the inhabitants to the existence of forests, originating in the common belief that they will continue to exist, no matter how recklessly treated, the desire of the villagers to get grazing ground for their cattle by burning the forests, the indiscriminate usage of the wood and method of felling in vogue, have destroyed hundreds of miles of forest, and have left the greater part of the Luneberg Heath barren, covered almost exclusively with heather, and of little use to any one. Now the evils are seen, and with a view of restoring these forests large sums of money, and much skill and labour, are being expended.

I will quote here a short description of the method used in planting the Scotch fir in such localities. The land is first ploughed, after which a man proceeds along the bed, making holes at distances three feet by five, with a wedge spade (one quite straight, made all of wood except the edge, which is shod some inches high with iron, and is two inches thick at the top of the blade). This he forces into the ground, withdraws it, and passes on, while two women follow him, who plant by holding the seedling against one side of the hole, while with their foot they press the opposite earth against the plant. The material for planting consists of one-year old seedlings of Scotch fir, and occasionally a two-year old seedling of spruce, which are raised in the ordinary way by sowing in furrows. The Scotch fir requires more light and air than any other, and does not thrive at

all in the shade of other forest trees. For the same reason natural reproduction (in forests) is very difficult, and not attempted here. As a tree affording some shade to other trees which require it, the Scotch fir is well suited. If sown or planted very close, early attention to thinning out also is necessary, as plants early stunted never fully recover their strength. The soil not being rich, the trees are not allowed to grow older than sixty to eighty years, this being the age at which the comparative yield of wood is best. Spruce is planted in small numbers with the Scotch fir, and even where the soil is not good enough for it to grow up into large trees with the fir, it becomes beneficial by the cover of its dense foliage, which facilitates decomposition of the soil, and keeps it moister and cooler than the fir alone could do.

It will, perhaps, be as well here to give Mr. Mann's very lucid description of beech culture :—

Seed beds for beech are prepared in the ordinary way, and the seed is sown in autumn as well as in spring. If the former time is preferred, care has to be taken that the seed does not germinate too early, so as to be exposed to spring frosts. This is prevented by covering over the beds after the surface gets slightly frozen, and by removing the covering in spring so late that the young seedlings have nothing more to fear from the frost. If sown in spring, the seed has to be carefully stored during the winter. Steaming, as well as excessive drying, must be guarded against. The first is avoided by turning over the seed or even keeping it spread out; the second by slightly watering it and turning it over afterwards, so as to distribute the moisture equally. A cool, moist room on the ground floor is preferable to a warm and dry one.

From the seed beds the plants are either removed at once into the forest, or into other nurseries for transplanting and keeping until they reach a height of three or four feet. If they are to be planted in open ground, without the protection of old trees, they are sometimes kept in the nursery until they reach a height of ten or twelve feet, which however is a very expensive measure. In this care is taken that the young shoots are not removed from the stem, as the bark of the beech is very easily burnt by the sun, and otherwise apt to be damaged by the weather. Unnecessary exposure of the roots of the young beech is carefully avoided, as they are very sensitive, and demand special care during the removal of the plants. Where it can be done some of the soil is left on the roots for the same reason.

Ordinarily the beech forest trees get re-established by natural production, *i. e.*, the shedding of seed from old trees. When the beech gets mixed with other kinds, as in the coppice with standard, its regeneration is furthered or checked according to circumstances, but planting is seldom resorted to.

In the pure, high forests of beech the natural reproduction is brought about by gradual and well-considered fellings, which tend to effect this as completely as possible. In hilly or mountainous localities fellings are commenced at the top of the hill. These fellings take place when the trees have reached maturity, and are three to four in number, and distinguished according to the immediate effect they are intended to have on the forest.

The first felling, called in Germany the preparatory cutting, is intended to facilitate the decomposition of the dry leaves and branches which cover the surface, and thus pre-

pare it for the reception of the seed, which latter, without this precaution, frequently germinates without being able to penetrate with its roots the comparatively hard and leathery leaves lying on the surface, and often dies in consequence, while weeds and scrub easily get up in it, and cover the surface soon, thus adding to the difficulties to be overcome by the young plants. It is commenced several years before the intended regeneration, and carried out gradually; but where the air and light thus admitted are not sufficient to render the surface fit for the reception of the seed, a timely permission to villagers to remove some of the dead leaves is resorted to. Besides the preparing of the soil, this opening out of the forest induces the tree to flower and bear seed more frequently than when standing very close.

The second felling—the so-called seed-cutting—is carried out as soon as the bearing of seed becomes probable, which can be judged of beforehand by the appearance and shape of the buds during the preceding winter. An abundant seed-bearing season generally occurs with the seed after longer or shorter intervals, but sufficient seed for the regeneration of the forest may be reckoned on every second or third year. Precaution is used not to remove too many trees at once, as in case of the flowers being destroyed by spring frosts or other causes, the restocking of the ground with young plants does not succeed. Too much light would dry up the surface of the soil, and induce the weeds to overrun the ground, both circumstances seriously interfering with the germination of the seed at a future season. Where at this time the suitability of the soil remains doubtful, a timely loosening and preparing of it in stripes and patches is resorted to to insure success.

When the expected seeding of the trees turns out a failure, further clearing is carefully avoided, to prevent the deterioration of the soil or overgrowing with weeds. If, however, the season is a favourable one, and produces sufficient seed, and the young plants germinate, this felling is soon extended to a greater number of trees to admit more light and dew to strengthen the young plants.

For the purpose of getting the seed worked into the ground, herds of swine, cattle, etc., are often driven through the forest with good effect.

Seed beds are sometimes established in the neighbourhood of a forest at the same time, to furnish young plants for the filling up of vacancies, which, however, are also obtained nearly as good out of the forest itself from places where the plants stand thick enough. Altogether the aiding of the natural reproduction by artificial means, either sowing or planting, is at the present time generally resorted to at once, as such measures always lead to a more satisfactory accomplishment of the desired regeneration, and save time.

The third felling is called cutting for light, as its chief purpose is to admit light and air in greater abundance as the young plants require it. This is generally commenced when the seedlings are two years old. It is also regulated very much by circumstances, and while in the one case the forest trees may be required longer on account of the spring frosts, so very injurious to the young beech, in others their early removal is necessary, even if an increase in size be sacrificed, for the establishment of the young trees. Neither do partial failures prevent the removal of the old trees, but are resorted to at once by

sowing or planting as the safest and quickest mode of securing the establishment of the young forest.

After the third or light felling follows the gradual removal of the old trees, or final clearing, which is regulated in the first instance also by the requirements of the young trees, and after this by the fixed yearly out-turn, as laid down in the working plan. As a general rule, all these fellings are carried out gradually, without causing sudden changes in the forest. The aiding of natural reproduction is either accomplished by sowing, if failures are perceptible early, such as non-germination of the seed or death of the seedlings; or by planting, if the seedlings get destroyed later by spring frosts, or are choked by weeds. The sowing is carried out in the forest in strips two feet wide, in furrows, or in patches two to three feet square, prepared by hoeing for the purpose, and by loosening and levelling of the soil; while planting is done by seedlings two to three feet in height taken from adjoining nursery beds, or from spots in the forest where there are more than are necessary.

"It is evident," says Mr. Mann, "that if, with all this care and attention to aid natural reproduction, still occasional failures occur, how unreasonable it is to expect forests in India to keep in an equally rich and thriving condition if left to themselves, or worked only with a view of extracting the timber from them." I would also apply the remark to Canada, and observe also that Captain Clarke respecting India, and Hon. M. Joly concerning Canada, make precisely the same statement, to the effect that the forests in both countries, cut over and carelessly managed, are often, so far as any available supply of good timber is concerned, only forests in appearance.

It may be noticed that the beech, of all other trees, is said to improve the land, forming a rich vegetable mould, to gain the benefit of which other trees—oak, ash, maple, larch, Scotch fir—are planted among the beeches, and do well. I may notice here that in Canada, while clearing the forest, this did not appear to me. I generally found the maple on the richest land, and where beech were intermixed a lighter loam.

One description of forest much used in Germany is called "Middle Forest." It contains a number of high trees cut at long intervals for timber, and below them a coppice (smaller trees growing from roots of previously existing trees, and which will themselves, when cut, be succeeded by similar ones) cut at much shorter periods for firewood. In cutting the coppice, young trees are left to replace the tall ones when cut.

A method of planting used here should be noticed. A small spade of solid iron, about twenty pounds in weight, fourteen inches long, seven inches broad at top, five at bottom, with a handle four inches long, is driven into the ground, and bent to all sides, then drawn out. The plant, three to four years old, of beech, spruce, or oak, etc., is dipped into a thin mixture of loam and water, which adheres easily. In this state it is pushed with its roots into the hole as far as possible, and with continual shaking, by which the roots get straight down into the hole, drawn up to the level at which the plant should stand. Here it is held by one man, while another drives in the spade a second time, about three inches from the first hole and parallel with it, and first presses with its point towards the first hole, and then with the broader part, by which means the plant gets very firmly pressed into the soil. If necessary the spade is driven in a third time, to close up the second hole slightly. The soil is then beaten firm with a mallet all round

the plant, but not striking closer than three inches. This mode is very successful ; it is carried on without preparing the soil, and answers in stony ground, on account of the strength of the spade.

On the Harz Mountains (the scene of many a supernatural legend) are vast forests of spruce, kept with much care. One remarkable point in the management is the Government seed-drying kiln at Westerhof, for getting the spruce seed out of the cones and cleaning it of wings, which is carried on here extensively, the spruce being plentiful, of excellent growth, and producing exceptionally good seed. The cones are collected by contract work, and varies according to the seasons, if plentiful or otherwise, and generally enables the workman to earn 50 cents to 75 cents per day. After all the Government stores are filled, private persons are allowed to collect, for which the person has to pay a small sum per season. In the cones the seed remains good from seven to eight years. The Government kiln turns out about 180 cwts. per season, while private parties in good seasons have turned out as much as 1,600 cwts. besides. The cones, when first brought in, are stored in large rooms, with perforated walls, so as to admit a free current of air through them.

The kiln itself consists of three rooms, the centre one of which is heated by means of a large oven, from which large iron pipes, six inches in diameter, pass twice through the room before they enter the chimney. This room is separated by walls, in which there are holes of nine inches, from the two outer rooms, in which the cones are being dried. By means of these holes, which can be closed at pleasure, the temperature in the drying room is regulated, and kept between 122 and 128 Fahrenheit. The drying is done in large wire drums, out of which the seed falls on the floor of the room. There are twelve in each room, and are turned from the outside of the room, where it is cooler. They are filled in the evening, the temperature got up, and so left for the night. The next morning the fire is lit again, and the drums being turned every half hour, by night the cones are empty. Half the cones are used to heat the kiln ; the rest sold for fuel. It costs Government about six cents per pound. What is not needed is sold at nine.

It is noticeable that the spruce wood, among other uses, is ground into pulp for paper manufacture, several mills in the Harz Mountains being employed in this manner. It might be worth consideration whether, under an improved system of forestry, the waste wood left in such quantities in hewing and score-hacking could be, in our great Canadian spruce forests, so employed.

It will be well to give an account of the method of reproducing and caring for spruce forests, both because our own forests will soon need replanting, and to give some idea of the care taken in maintaining woodland property in foreign lands.

Natural reproduction of the spruce is seldom attempted, as too slow and uncertain ; but if there are thriving naturally some clumps of any extent, they are kept up. Almost all spruce forests are regulated high forests, with complete clearings, either re-sown, which is still preferred by some, or planted, which is by far the most general mode of establishing or re-establishing spruce forests. If sown, lines about two feet in width are prepared by clearing the weeds, etc., off the ground, and placing this at the edge of the lines to prevent the wind blowing among the seed, or rain washing them off. The soil on these strips is sometimes loosened and left as it is if the seed is to be sown broadcast. If

the seed is sown in rows, small furrows are made. Between the strips, ground twice as wide is left. For plantations, the seed is sown in seed-beds, which are good, even, and sheltered pieces of land, about half an acre in size, and well dug up, afterwards levelled and occasionally slightly manured by the ashes of the weeds, remains of wood, etc., collected on the surface, brought together and burned, and afterwards mixed with the soil. These seed-beds are usually in the immediate neighbourhood of the ground to be planted, and have to be fenced in. If the seedlings, after they are three or four years old, have to be removed from here at once to the spot where they are to remain, the seed-beds have to be larger, especially if the young plants are to be planted out in numbers, *i. e.*, three or four in one hole. In the latter case the seed is sown generally in furrows, one foot apart, as being more convenient, and requiring here in the hills about seventy-five pounds of seed for half an acre, which is sufficient to plant fifty acres of forest. The better plan, however, is to have the plants from seed-beds, after they are two years old, transplanted singly into a nursery at about seven inches distance, where they remain until they are four or five years old; this, however, requires as much space again for the nursery as for the seed camp. Not unfrequently four to six year old seedlings are taken from the adjoining forest, where they are generally so close as to permit of the removal of many of them; and this is the most inexpensive way of procuring seedlings in limited numbers. Where there is a demand for thinnings, the planting of three or four plants in one hole recommends itself. If it is likely that the ground get run over rapidly with weeds, or the soil dried up by the sun, the replanting is done as soon after the removal of the old forest as possible, whilst where the danger from insects, especially the small beetle, is great, the ground is let lie two or three years first. Planting is done in autumn as well as in spring, but the latter is preferred. Spruce is planted four or five feet apart.

To protect the spruce forest against damage from insects the forester has to be constantly on the alert, as they are many, and if not checked in time, great damage is done by them. The most destructive noticed was the ordinary spruce bark beetle, which attacks the bark of living trees, and had, in some of the localities visited by the commissioner, destroyed so many trees that, when the diseased were removed, the forest had become so open that the wind would soon have removed the rest had they not been felled. Experienced men are told off to guard against this danger, by going through the forest to search for the trees attacked by the beetle, and fell and bark them to prevent the spreading of the insects. In most cases, they are quite able to hold the insects in check. These generally attack trees loosened in the roots by wind, known after the beetle gets in by their foliage turning yellow. In spring, when they are worst, healthy living trees are felled at the southern margin of the forest in sunny spots, for the purpose of attracting the beetle. Such trees are often full of them three or four days after being felled. The trees attacked are barked, which destroys the larvæ if not too far advanced; if so, the bark is burned. To prevent any escaping while barking, a cloth is spread under the stem. The timber beetle, which attacks new felled trees, going deep into the wood, is also common there, and is watched for closely. For the young plantation of spruce the first mentioned is the most dangerous, as it eats off the bark above the roots, and kills the tree. Fresh pieces of bark a foot square, inner side down, are laid around before or after planting. The beetles go under, and are caught and killed. The bark is examined every morning.

SILVER FIR AND SPRUCE IN THE BLACK FOREST.

The Black Forest mountains are the home of the silver fir. The winters are severe—five to eight feet of snow on the hills from November till April ; three feet in the valleys from December till March. They are partly regulated forest, in which, however, a gradual felling for their reproduction is carried on over one-third or one-fourth of the whole area at once, from which every year during thirty or forty years the largest trees are removed, while the rest are allowed to grow larger during the remaining years. This is done, as the price these large trees fetch is much higher in proportion than that of the smaller ones, and all are felled and removed in one piece if possible. Natural reproduction is chiefly resorted to in these forests, which, in consequence of the young plant growing well in the shade of the old trees, is very easily accomplished, even though it is extended over such a long period as thirty or forty years. To be able to keep as many trees as possible growing on the lands on which the regeneration of the forest is going on, the branches up to one or two-thirds of the height of the tree are sawn off to admit air and light to the young plants below, which does no harm to the silver fir, but, on the contrary, is said to aid the more rapid increase of the trunk, while the branches are used for litter. This sawing off of the branches is commenced from above by men who earn about forty-five cents a day. Regular seed-bearing seasons occur at longer or shorter intervals, but nearly every year there is sufficient seed to increase the number of young plants where it is wanted. Moss cover is very favourable for the germination of the seed, whilst in such places as get covered with grass or weeds, or where for other reasons the seed does not germinate freely, the soil is at once prepared, by clearing and slightly loosening it in strips and patches, for the reception of the seed, the germination of which is thus facilitated. If the open space in the forest is so large that the seed from the old trees does not reach the whole of it, sowing by hand is resorted to early, so as to let the young plants be as nearly as possible of the same age. If, by the time the old trees are nearly all removed, there are still some parts not covered with young trees, planting is resorted to. For the better growth of such planted trees the existing groups are somewhat rounded off, to avoid the young trees planted having to struggle with the others, perhaps already twenty to thirty years old ; and where, on incompletely stocked spaces, which have to be filled up by planting, there are single trees of some twenty or thirty years, they are cut down altogether ; or, if they are standing in numbers, and are not quite so large, some of the lower branches are lopped off the outer ones, so as not to interfere with those planted. These plants are either taken from nurseries or out of the forest, if the latter have not grown in too deep shade, which would render them liable to suffer on being removed to open places.

The seed is collected with some risk from the trees in October, before the cones open and it falls out. As the seeds are very oily, they are best kept in the cones or sown at once. The sowing is done in prepared beds in rows four inches apart, and after germination the ground is covered with moss to keep in the moisture. The seedlings one year old are transplanted into rows six or seven inches apart, and three inches between the plants in the rows, after which the soil between them is also covered with moss. Here they have to remain for two or three years before they are fit for transplanting. Shade

from the side is very beneficial for the seed beds as well as for the nursery. Plants for the nursery are preferable to those out of the forest; and the latter, when used, are as a rule removed with some of the soil adhering to the roots. Planting is better done in spring than in autumn, and in the usual way, the roots of the young plants being cut as may be necessary. They have to be sheltered as far as possible against sun, dryness, or spring frosts, and the plants as a rule thrive better on the cool northerly and easterly slopes of the mountains than anywhere else. The silver fir grows very slowly at first, and does not get much higher than six inches in the first four or five years. At the age of twenty-five years it begins to grow very fast, and increases most between the ages of eighty and a hundred and twenty years. It likes best a deep, cool, moist and loamy soil with a covering of moss, and sends its roots deeper than the spruce, in consequence of which it suffers less from wind and storm than the latter. There are many spruce intermixed, used when natural reproduction of the silver fir fails. Thinnings are necessary in the thirtieth year, and have then to be repeated every tenth year, till the gradual felling of the largest trees commences. These fellings are regulated by the needs of the young seedlings, and are carried out only sufficiently to admit light to the young plants, leaving as many of the old trees to stand as can be permitted.

Moorpan.—In Hanover and elsewhere, where the Government are bringing up thousands of acres of heath for the purpose of planting forests, great difficulty is found in penetrating and converting into good soil a hard layer called “moorpan.” This is broken by plough and pickaxe, and Scotch firs planted, whose deep tap-root passes down into the layer of better soil below. The Government pay about \$11 an acre for the land.

FRANCE.

The administration of forests in France is entrusted to the Ministry of Finance, and the head of the Department is the Director-General, assisted by two administrators, one charged with the management of the forests and the sale of the products, the other with the police of the forests and the forest laws. In the departments there are thirty-two conservators, each in charge of one or more departments, according to the extent of forests in each. The immediate supervision is entrusted to inspectors, who are assisted by sub-inspectors and *gardes-generaux*, who live near, and personally superintend all operations and work of the forest guards. The brigadiers and forest guards live in houses in the forest and serve as a police over a certain range. They are required to be present at all operations, and to go round their ranges at least once a day to report any violations of forest law that may take place.

The saw-mills in the forests are usually owned by the Government and hired at a certain rate to the wood merchants, who buy the cuttings. The timber is allowed to be sawn up before it is inspected and marked by the forest guard under the superintendence of an inspector.

The forests under the management of the bureau are (State and Commune) about 7,500,000 acres. There were nearly a million more, which went with Alsace and Lorraine to Germany. Also, there are in France 15,000,000 acres of private forests.

Of schools of forestry, the French have, at Nancy, one of the best in the world,

where pupils are instructed both experimentally and theoretically in all forest learning, the collegiate home studies being constantly varied by excursions of parties of pupils, under charge of professors, to those forests where, at the time, most can be learned. Proficiency in these schools forms, of course, a strong recommendation to future advancement in the Government or private forest service. For admission to the school candidates must bring a letter of authorization from the Director-General of Forests, which can only be obtained by those from nineteen to twenty-two, without infirmities, and having a diploma of Bachelor of Letters, or attainments in classical studies to warrant such diploma. They must also have an income of \$300 per annum, or a pledge from friends to provide it, and \$120 afterwards till employed as garde-general on active duty.

In the difficulties which have hindered the efforts being made, especially in America, to preserve a due amount of forest, one of the most formidable has been the disinclination to interfere with private rights. It will be of service in Canada in this matter to notice how summarily, in France, this matter has been managed. I will therefore quote the principles of law upon which the forest code of France is founded, as stated with great precision by Professor Macarel (a writer deservedly of the highest estimation) in his "*Cours de Droit Administratif*." As they embrace views applicable in other countries under like necessities—being, in fact, an extension of the right of eminent domain, or that maxim of Roman law, *salus populi suprema est*—they will be especially germane to our purpose. He says :—

"Restrictions Implied in the Free Enjoyment of the Soil."

"As to the woods and forests :

"The preservation of forests is one of the first interests of society, and consequently one of the first duties of Government. It is not alone from the wealth which they offer that we may judge. Their existence is of itself of incalculable benefit, as well in the protection and feeding of the springs and rivers as in their prevention of the washing away of the soil from mountains, and in the beneficial influence which they exert upon the atmosphere.

"Large forests deaden and break the force of heavy winds that beat out the seeds and injure the growth of plants ; they form reservoirs of moisture ; they shelter the growth of the fields ; and upon hill-sides, where the rainwaters, checked in their descent by the thousand obstacles they present by their roots and by the trunks of trees, have time to filter into the soil and only find their way by slow degrees to the rivers. They regulate, in a certain degree, the flow of the waters and the hygrometrical condition of the atmosphere, and their destruction accordingly increases the duration of droughts and give rise to the injuries of inundations, which denude the face of the mountains.

"Penetrated with these truths, legislators have in all ages made the preservation of forests an object of special solicitude.

"Unfortunately, private interests—that is to say, the action of those who do not directly feel the power of the Government—are often opposed to this great national interest, and the laws framed for protection are often powerless.

"In France, the ordinances prior to the revolution carried too far the restrictions imposed on private owners. The new regulations fell into the opposite extreme, and allowed the proprietors free and absolute liberty to dispose of their woods.

"A large destruction followed this imprudent translation from excess of restraint to excess of liberty. The proprietors abused this unwonted freedom, and clearings multiplied indefinitely, without distinction as to the places where they were made, so that in many localities the rushing down of the denuded soil and the deforesting of mountains caused the soil needed for vegetation to disappear and left the rocks naked. The rise in the price of wood and the easy and certain resource offered to proprietors in the clearing of a

planted tract, when compared with the remote and eventual advantages offered in their preservation; the hope of compensation, and, beyond this, the advantages, in one way and another, of cultivation, may be recognized as among the causes which sufficiently explain the inducements offered to many of these proprietors, which led them to undertake these clearings."

I would here notice that this is precisely what we have been doing in Canada, and that the ill effects which followed in France will surely in no long time be felt in Ontario. They are already felt; we have not the climate we had, nor the favouring moisture when most needed. Yet we could get along as we are. But that is just what is impossible. We must, while there is time, use some means of averting the evil, or we shall certainly become much worse off than we are. M. Macarel goes on:—

"At length, this progressive deforesting of the soil of France, joined with the incessant need of firewood, and the demand for wood by manufactories and ships, have, during forty years, made sad havoc with our forest wealth.

"A renewal of the ancient prohibitions by the law of 9 Floreal, year XI., was deemed necessary to oppose this excessive clearing of woods by private owners. It was accordingly decreed that, during the twenty-five years dating from the date of the promulgation, no wood should be cut or carried off unless six months' notice had been given by the proprietor to the forest conservator of the arrondissement of the district in which the wood was located. Within this time the forest administration might object to the clearing off of the wood, and was charged to refer the question before the end of this time to the Minister of Finance, upon whose report the Government might definitely decide within the same time. It therefore resulted in this, that to make a clearing an authorization precedent by the administration was necessary, and that if the administration thought proper not to grant this, the proprietor was restrained against cutting.

"Thus, according to this branch of agricultural industry, the general law of France is, that owners are free to vary, within certain limits, the cultivation and working of their lands; but, as to woods and forests, the public interests demand that individuals shall not be free to clear them from the soil whenever they please. From hence it follows, that the administration has a right to pronounce its prohibition against clearing whenever it is deemed that the public interests require that this be done."

The penalties for clearing when forbidden are, I may state, a fine of about \$200 per acre, and compulsory replanting within three years. This law was, I conceive, in full force in 1874, as this quotation forms part of a report to the U. S. Congress of that year. It probably is in force still, and justly so. The voice of the people, not of solitary citizens, should decide in so important a matter as deforesting a country.

The French Government have, at great expense, replanted vast and almost barren districts; they have also established great forests along the sea-shore where formerly the sand threatened to destroy whole departments, and have averted the evil. But the chief means is the prohibition of clearing; for it is the interest of an owner who does not clear to plant and improve his forest, so as to receive an increased income from the trees arriving at maturity in increased numbers yearly.

SWITZERLAND.

In no country in Europe has the waste of forests been more rapid or destructive than in Switzerland, and in none, perhaps, has this improvidence been followed by more disastrous results. The woods, being considered common property, were uprooted; and the soil on the mountains being exposed to the wash of the rains, was rapidly carried

away, leaving broad areas of naked rock, from which the water would at once sweep down the valleys in sudden and destructive inundations. The autumn of 1868 is memorable on account of these floods.

Public attention has, however, been thoroughly awakened, and active measures are in progress to remedy, as far as may be, these evils. The cantons which have charge of these operations have for some time, at great expense, been constructing works to control the streams, and planting trees wherever practicable.

I would here remark that this is a very difficult matter compared with what it might have been. It is easy to preserve a forest on a hill-side, but the soil once washed to the rock, it is another matter. I could point out places in Ontario where splendid forests stood, and yet might have stood, now for many miles

“White rock and grey rock,
Barren and bare.”

The matter is now in Switzerland taken into the hands of the national Government, and the following article gives the idea :—

“Art. XXII.—The Federal Union of Switzerland has the right of supervising structures for the protection of water courses, and of the forest police in mountain regions. It will assist in protective structures for water courses, and in the planting of forests at their sources. It will enact the requisite regulations for maintaining these works and the forests now existing.”

ITALY.

Soon after the present Kingdom of Italy was established, a central forest school was organized near Florence, under the direction of A. di Berenger, formerly in the Austrian forest service of Venezia, and author of an excellent work on the history of forest management in Italy. The school is located in the splendid silver fir forest of Vallombrosa. We all remember

“Thick as autumnal leaves that strew the brooks,
In Vallombrosa.”

This is below the crest of the Appenines, on their western slope, about twenty miles east of Florence. In winter it is transferred to a lower station at Paterno, in the region of the olive. Italian forest literature of direct practical application is comparatively modern, but of late the publications of the Ministry of Agriculture, to which sylviculture is entrusted, contain much that is valuable. The two most important of these give the statistics of forests and the forest law of Italy. There are over five million acres of communal forests, over six million of private forests, and only half a million acres of State forests. One-fifth of the land is in forest. This is scant enough, apparently, or the nominal forests have been culled to depreciation, for we are told that—

“Projects of a general forest law for the whole of Italy have been repeatedly submitted to the Italian Parliament. The evil effects of denudation have been severely felt in many parts of the country, and the aim of these proposed legislative enactments has hitherto been to guard against further mischief by determining beforehand which lands shall, in the public interest, be clothed with forest or kept under forest, and then to place the whole of these lands under the supervision or control of the public forest officers without distinction, whether they belonged to state, village, commune, or private persons. From a report with which the Minister of Agriculture submitted the project of a general

forest law in 1870, it appears that the financial exigencies of the country had rendered imperative the alienation of the greater part of the forests at the disposal of the State, and that it was only intended to retain a limited area of State forests, mainly with the view of supplying the timber required by the navy, and the forests required for this purpose the bill proposed to declare inalienable.

"Thus, with regard to forest matters," says Captain Walker, "it seems probable that Italy will pursue a policy different from that which has of late years been initiated in most provinces of India. In those provinces we acknowledge the necessity of maintaining certain areas under forest, or of clothing them with forest when they are bare; but we do not expect any satisfactory success in those attempts, unless the forests to be thus maintained or created are under the entire control of the State, and we entertain no serious hopes of effecting any real good by the supervision of private forests, or by any general kind of control over communal forests, unless the administration or management of such communal forests can be vested entirely in the hands of the public forest officers.

"In those provinces, therefore, of the Indian Empire, to which I now refer, our principal aim is, in the first place, to consolidate the State forests wherever the State has suitable forest lands at its disposal; and we hope that eventually, when the majority of public forest officers shall have acquired that professional knowledge, skill, and experience which is necessary for a satisfactory management of forest land, that they may be found competent not only to manage the State forests entrusted to their charge, but also to induce large landed proprietors to follow their example in the management of their own estates, and, if such should ever be found necessary and expedient, to exercise an efficient supervision over private and communal forest lands; but we think that any attempt to exercise supervision and control over private and communal forest lands through the agency of forest officers who have not actually charge of public forests entirely under their own control, and who cannot point to the management of their own forests as an example to be followed in the management of the private or communal forests, would lead to unsatisfactory results. The further development of the general forest policy in Italy will doubtless be followed with great interest by Indian foresters, and on this account it appeared to me right to add the present remarks."

It may be valuable here to notice that in this, as in other points, the practical ideas of the Indian commissioner might well be applied in Canada. There is good reason to fear over-denudation here; there is also reason to believe that we shall have an interval in which to take measures for avoiding the evil. In that interval the course stated by the commissioner as likely to be followed in India might, it appears to me, profitably be pursued here, namely, the taking in hand by Government of any amount of forest fit for the purpose, and which could be spared from the operation of the system at present pursued, and preserving them on the European plan. This will further on be more fully treated.

RUSSIA.

In this vast empire, where, as in the United States, we have been accustomed to believe the forest is interminable, and where, in fact, the amount of woodland in the northern two-thirds is more than twice as great in proportion to its area as in the United States, the Government has turned its attention energetically to the subject of forestry, and has undertaken to establish by regulation conservative measures. As yet, private persons and establishments owning forests enjoy the absolute right to cut and clear at will. But these do not own nearly so much as the Government, which has about three hundred and thirty million acres of woods; the others holding about one hundred and fifty. About forty per cent. of the country (Russia in Europe) is timbered. I must remark that this amount, after so long an occupation, shows that the timber has been taken

some care of already. For the immense Government woods, they have been placed under the care of the Minister of Public Domains, who has a director of the Forest Department, and the organization of the service is very complete. For the purpose of fitting young men for the duties of forest agents and agriculturists, either for the Government service or upon private estates, two special schools of agriculture and forestry have been established—one at St. Petersburg, and one near Moscow. The course of instruction extends through three or four years, and the schools are placed near forests, where every detail is illustrated. There is also another forest school at Lissino, of the second grade, where the course is very practical.

SWEDEN.

In 1859 a bureau of Forest Administration was created. Forest regulations, however, extend back to 1647, and even before that, private owners were required to plant and protect from cattle two trees for each one cut.

In 1868 a commission was appointed, under the direction of Mr. E. V. Alinquist, to enquire into the need of further legislation, and in December, 1870, he submitted a report with a bill, making 392 pages, besides numerous tables.

One clause in the reported bill is a compulsory feature, which, though less stringent, is in the spirit of the enactments now in force in most of the countries of continental Europe, namely, forbidding trees to be cut for sale smaller than eleven inches at the butt, or eight inches sixteen Swedish feet therefrom.

INDIA.

The necessity of preserving tropical forests has fortunately attracted the attention of Government in British India, where the importance of maintaining an equilibrium of temperature and humidity is of much immediate consequence to the social welfare; and the growing demands of railroad use, and the various applications of the arts, render it a subject of direct practical utility.

The matter has been agitated since 1850, and in 1864, Government laid the foundation of an improved general system of forest administration, for the whole Indian empire, having for its object the conservation of state forests, and the development of this source of national wealth. The experience acquired in the forest schools of France and Germany has been brought to apply in this great national undertaking. Among the more important general principles laid down for the execution of this measure is that all superior Government forests are reserved and made inalienable, and their boundaries marked out to distinguish them from waste lands available for the public. The Act of 1864, defining the nature of forest rules and penalties, has been adopted by most of the local governments, and the executive arrangements are left to the local administrations. Various surveys have been made to obtain accurate data concerning the geographical and botanical characteristics of the reserved tracts, and the kind of timber best adapted for various localities has been carefully ascertained.

In 1866, the Government resolved upon sending out five young men, duly qualified by education in the forest schools of France and Germany, for the forest department of India. An arrangement was made the same year by which forest officers in the India

service, who might choose to come to Europe on furlough, would be able to increase their professional knowledge by studying forest management and other subjects connected with forests in Great Britain and on the continent. A number of officers have availed themselves of these arrangements, and some of their reports have been published.

Of these, that by Captain Walker, and that of M. Gustav Mann, I have largely used elsewhere, as the reader will have observed.

"At the moment of our writings," says the author of a report from which I have obtained much, presented to the U. S. congress in 1874, "the public journals are giving most painful accounts of the distress in India from famine. From a careful study of this subject we cannot doubt that this calamity is due to the fact that the forests have, of late years, been swept off by demand for railroad and other uses much more rapidly than formerly, and that the exposure to winds and sun, thus occasioned, may have largely contributed to these painful results. The remedies are to be sought in the restoration of that due proportion of forest-shade upon which agriculture depends for success. If the officers to whom the opportunities for European observation fall, improve them as well as some reported by Captain Walker, we may reasonably hope for a radical though not an immediate restoration of abundant harvests throughout the vast countries of India."

Now, since this was written, we have Sir Richard Temple's valuable book, "India in 1880," which I have noticed before. This gives us some idea of what has been commenced by the gentlemen who have been writing the reports we have used. He says:—

"The Government of India has enacted a law regulating all matters connected with forest conservancy, and the provisions of this law are being carried into effect by the several local governments. The forests are divided into two categories; first, those which are 'reserved,' being preserved and worked through state agency, in a most complete manner; secondly, those which are 'protected,' being preserved less thoroughly. The best timber markets are mainly supplied from the 'reserved' forests. Care has been taken to determine what tracts shall be 'reserved' and 'protected,' and to mark off their boundaries. The area thus defined in the several provinces already, or likely to be defined ere long, will prove to be hardly less than eighty thousand square miles for the whole empire. The primary object of the administration is to preserve the forests for the sake of the country. Due attention is also given to the financial out-turn; much income is already secured. The expenditure is over five hundred thousand pounds annually, but the receipts amount to nearly seven hundred thousand, and in time the forest department will have a prosperous revenue.

"The superior officers of the department are for the most part British, trained in the forest schools of France and Germany. The Inspector General of Forests with the Government of India is Dr. D. Brandis, whose services to the empire have been conspicuous in organizing a system of forestry which is sound and scientific, and is yet adapted to the circumstances of the country. Instructions in forestry is afforded to natives also; forest schools are established for them, and in time they will take a large share of the administrative work.

"As might be expected, the system of forest conservancy, though generally accepted by the natives who dwell near the 'reserved' and the 'protected' tracts, is sometimes opposed by them. There must always be some danger lest the foresters should, in their zeal for conservancy, infringe upon the prescriptive rights of the inhabitants. The local civil authorities are vigilant and prompt in asserting and vindicating the rights of the people in this respect; for the recognition of which rights, indeed, ample provision is made by the law. They should, however, be careful to support the forest officers in the execution of duties which are of the utmost consequence to the welfare of the country. Many of the hill tribes habitually burn patches of valuable forest, in order that the ashes may so fertilize the virgin soil as to render it capable of producing a crop without tillage. Having reaped one harvest, they leave the spot marked by charred stumps of timber trees, and move on to repeat the same ravage elsewhere. This barbarous and wastefully des-

tructive practice is gradually and cautiously checked, by reclaiming these people from agricultural savagery, and inducing them to plough lands, and raise yearly crops by ordinary husbandry.

"According to the latest returns there appear to be 29,600 square miles of demarcated reserve forests, 3,500 square miles of protected areas, and 35,000 square miles of unreserved forests, or 68,000 square miles in all. This appears a comparatively small area for so large an empire, especially when it is remembered that of this not more than one half is effectually preserved. Some extensive forest tracts exist, however, in the Madras Presidency, of which a return remains to be rendered. There are, further, 31,000 acres of plantations in various districts."

These plantations, I may remark, are those commenced by the foresters under Dr. Brandis, and are being every year added to at the rate of some thousands of acres. It may be noticed that the forest officers trained in Europe for India, and at work there now, number forty-six out of a staff of ninety-three, who have, of course, an immense number of subordinates.

Concerning other countries, it may be generally remarked, that all the nations of continental Europe are moving in forestry matters, and that there are many schools besides those I have mentioned.

SOUTH AUSTRALIA.

The colonies of Australia and New Zealand are working earnestly in the matter of tree culture. In South Australia there is, we are told, far too little woodland. The consequences are that so arid is the country in parts that the reports state they can never expect to grow wheat unless the rainfall can be, by the assistance of plantations or otherwise, increased.

South Australia has moved vigorously in the matter. They have appointed a Conservator of Forests, Mr. J. E. Brown, F.L.S., who has written a valuable work on tree culture there. Reserves have been mapped out, of which one is about fifty thousand acres, another nine thousand, another twenty thousand, with smaller ones of six or seven hundred—the larger evidently intended to be improved into forests on the European plan—the smaller as nurseries and seed-bed for young plants. Houses have been built for nurserymen, and all suitable buildings erected, and forest rangers and police appointed. The Forest Board had been in existence three years in 1879, and from the report of operations sent in by Mr. Brown in that year, giving full and admirably worded details concerning the soil, trees, and method of procedure adopted and to be adopted on all the reserves, there is little doubt that South Australia will, considering how rapid growth, when encouraged, is there, (twice as rapid as in Britain) soon possess large and valuable forests, fit to yield yearly a regular and large quantity of timber, without either clearing or injuring the woodland reserves.

NEW ZEALAND.

To show the destruction of timber even where unnecessary for clearing, it may be observed that it is evident New Zealand possessed, when first colonized to any extent, in 1830, much land in a prairie or unwooded state, as her area was sixty-six million acres, and her wooded area twenty million acres. However, by 1868 she had destroyed five

million acres of woods ; and by 1873, she had lost eight, leaving her but twelve million acres. The destruction was principally caused, not by clearing, but by carelessness in allowing bush fires ; and it was evident the land would, at that rate, soon be deforested altogether. The well-known writer, Hochstetter, says:—"Individuals should not be suffered to turn the country into a desert to the detriment of whole generations to come. The woods are ransacked and ravaged, in New Zealand, with fire and sword. During my stay in Auckland, I was able to observe from my windows, during an entire fortnight, dense clouds of smoke whirling up, which proceeded from an enormously destructive conflagration near the town. When the fire had subsided, where had been a large beautiful tract of forest was now nothing but ashes." An official of the New Zealand Company had also pointed out the destructive propensities of the settlers in cutting down valuable wood. He says :—"A melancholy scene of waste and destruction presented itself to me when I went up to see the forest. Several square miles of it were burning, having been fired in order to make room for the conveyance of logs down the creek. Noble trees, which had required ages for their perfection, were thus ruthlessly destroyed in great numbers."

In consequence of this state of affairs, public opinion in New Zealand was loudly expressed, and numerous reports were presented to the Legislature causing animated debates, and large and valuable compilations of these were published. By this time, there is every reason to believe, if these reports and plans have been properly attended to and carried out, New Zealand has made good progress in the matter, though we have not, as in South Australia, an actual Forest Literature, such as the conservator there has published.

UNITED STATES.

The United States have for some years past established a bureau of forestry under the able superintendence of Dr. Hough, who has issued several valuable yearly reports, and whom I have to thank for copies of these as well as for other valuable publications connected with the subject. Largely in consequence of Dr. Hough's labours, tree-planting is receiving a rapid impetus throughout the United States, especially in the prairie sections ; while in many of those States which have been principally cleared of their forest, great interest is being created in the subject, and important works being carried out.

EXPERIMENTS IN PLANTING IN THE STATES AND CANADA, AND DIRECTIONS FOUNDED THEREON.

TREE SEEDS.—METHODS OF PLANTING.

In a report of a committee upon forestry, made to the Iowa State Horticultural Society in 1875, by Prof. Henry H. McAfee, the following practical statements are made upon this subject :—

"Seeds may be classified for purposes of treatment into three sorts, viz : nuts, hard seeds, and soft seeds. The nuts should always be planted where they are to remain permanently, as the nut-trees do not usually transplant without considerable injury, and the nuts must be kept damp from the time when they are ripe till planted ; at least the kernel must not be allowed to become dry, or they will surely fail to grow. Thin, soft-

shelled nuts, like the chestnut, will, if exposed to sun and air, dry in a few hours enough to prevent growth. So nuts must be kept in earth or on the earth under mulch, or in something that will prevent drying till used. Peat, moss, old straw, dust, etc., will do. A very good way is to spread them in a thin layer upon the ground, or in a trench so located that water cannot stand among them, and cover them thoroughly with mulch, planting them at corn-planting time, and about as deep as corn is planted.

"The hard seeds are generally somewhat slow to germinate, and need to be in soak for a long time, to be frozen wet, or to be scalded before planting, or to be treated with some substance to hasten germination. This class embraces honey-locust, which is kept dry and planted in spring, will seldom ever grow the first year, and sometimes will not sprout till the third season; also the stones of cherries and plums and even the seeds of apples and pears. If mixed with sand (two parts of sand to one seed by bulk) and dampened fully, and subjected to moderate freezing through the winter, all this class except honey-locust, coffee-nut, the hawthorns, and red cedar are likely to grow the season planted. For these exceptionally hard cases water, heated to boiling, is poured over them, and, standing upon them for an hour or two, some may swell, and can then be picked out and planted, and the more incorrigible treated to another scald, and thus till they all swell, or they are planted in fall and left to grow when they will; or, in case of haws, they may be mixed into bran-mash and fed to sheep or cattle, and the droppings planted, when the seeds, softened by the digestion, are likely to grow.

"The soft seeds, comprising all not named in the two other classes, may be still further divided into spring, fall, and winter seeds, each of which require or permits different treatment. The spring seeds are those which ripen in spring or early summer, as silver or red maples and red and white elm, all ripening from May 15th to June 5th, and the rock-elm a little later than the others. These seeds will not keep well and should be gathered from the trees before they fall, except where they are so situated that they may fall into still water, when, being light and floating, they may sometimes be scooped up in large quantities. As soon as possible after gathering they should be planted, not covered deeply, say one-half inch, in good mellow soil; and if a fine mulch, like damp chaff, can be obtained, it should be lightly spread over the ground, which sometimes takes place in June.

"The winter soft seeds are ash-leaved maple, green and black ash, sycamore, bass-wood, etc., or those seeds which have a tendency to hang all winter in sheltered localities. These seeds may be gathered sometimes as late as planting time and immediately planted; but if gathered earlier, had better be spread thinly upon the ground, and covered till planting time. All others of the soft and winged seeds, not classed as spring or winter, are the soft fall seeds, and they should all be stored as directed for the nuts. Hackberry and cherry, though properly classed with the hard seed, should be freed from their pulp in fall and stored in earth to freeze, and planted in spring without scalding. All seeds, but nuts, which are large enough to pick up readily, and such as may be gathered floating on still water, as noted above, are best gathered from the trees and stored so as not to dry too much. They must not be kept in too large masses, as, so dealt with, they may heat and spoil.

"If ground is not very weedy, it may be economy to plant all seeds in permanent plantation; but in old or weedy ground it is generally best to grow them in seed-bed or nursery rows. If put in the permanent plantation, allowance should be made for poor seeds, and more planted than you want of trees. The question of check-row or drill planting is to be decided by the planter, and the same reasons which determine the manner of planting corn have weight in forestry, though, generally speaking, forestry is more satisfactory in drills than is an annual crop like corn. If check-rows are used, several seeds per hill are desirable; and if drills, generally twice or three times as many seeds as you need trees should go in. It is not worth while to put tree seeds into any but mellow, moist soil, and to secure good results with them, thorough culture the first year is necessary. A rule of depth sometimes given is to cover with soil as deep as the seed is thick, and that is of course very thin for small seeds. But seeds of trees often get covered too deep, and any seeds but the nuts ought to grow with half an inch of fine earth lightly packed above the seed. Nuts may be planted a little deeper, but not much.

"Seed-beds and nursery rows are, all in all, to be advised, and they are generally used for seedling trees. Seed-beds are usually four feet wide and of any convenient length, and four inches above the surrounding level. For evergreen and larch seeds, which, by the way, ought not to be attempted by any one not trained in the nursery business, shades are used in the form of lath hurdles, with openings of less width than the strips, and generally, in addition to the hurdles, windscreens around the beds, while some nurserymen build arbors over their seed-beds, and such seed is generally put in broadcast, covering by sifting on sandy earth. But for any of our native tree-seeds, shading will hardly be necessary.

"Drills across the beds one foot apart may be planted, or drills, twenty to twenty-eight inches apart, may be made of any length, and on the general level, and the seeds planted at the rate of twenty to forty to the foot. Culture, while plants are young, should be by hand, running a hand wheel-hoe, and hand-weeding in the drill, if necessary; but when the trees have attained some growth, a steady horse may be used, and if the nursery is made of long rows, of course horse labour is better employed than if it is in short rows. Most of the native trees will be fit at one year old to remove to permanent plantation, and if to be so used, should be dug in the fall, and stored by burying, or in cellar, ready for early planting the next spring."

EVERGREEN PLANTING IN NEBRASKA.

As to the proper season for planting evergreens, the author of an article in the Fourth Report of the Nebraska State Board of Agriculture, remarks :—

"The exact time when evergreens should be moved has excited much discussion, and there is a wide difference of opinion as to the proper season. My experience after repeated trials, is that just when the buds first begin to swell in the spring is the time; while those removed after they have grown an inch were mostly failures. While a deciduous tree, when planted, is without leaves, an evergreen has an abundance of foliage to give off evaporation. Just at the time mentioned, the spongioles have commenced vigorous action; the resinous sap is thinned, and what is needed to secure a new growth is careful handling; see that the earth, which should be in close contact with the roots, is finely pulverized, and avoid by all means giving too much water. To insure the growth of any tree a certain amount of warmth in the soil is necessary. This cannot be found when the planting is done early in the spring, and in consequence the fibres lose their vitality and are unable to draw the required nourishment. Advantage should be taken of cloudy days, when both roots and tops are not exposed to the hot sun or drying winds, and, if the ground is moist, sufficient water only is needed to settle the earth about the roots, and then mulching to some distance round the tree will retain the moisture and keep down the weeds."

RULES OF E. FERRAND ON EVERGREEN CULTURE (NEBRASKA).

Suggested by Ten Years' Experience as an Evergreen-tree Raiser, and Ten Years as an Evergreen-forest Planter.

"1st. Never plant your evergreens in the fall of the year, but do it in the spring as early as you can obtain the trees.

"2nd. Do not set your trees in the ground deeper by an inch than they stood in the nursery. Use no manure of any kind in planting evergreens or larch, but let the soil be mellow and friable, without lumps in contact with the roots.

"3rd. Do not plant trees under two years' old even for stocking a nursery, and for the garden and lawn give the preference to trees one to three feet high.

"4th. Never dig deep among the roots of your trees, but keep the soil mellow and moist at the surface by a high mulching of bruised straw or hay, that will prevent the weeds from growing.

"5th. Last, but not least, get your trees direct from a nursery, carefully avoiding

trees that are hauled in by peddlers in the fall, because such are always killed at the root, notwithstanding their green appearance; and here allow me a little digression. Give your preference to home nurseries. You have men here engaged in the business, who have spent their life-time judging what varieties of trees you could better plant, for your profit and success."

METHOD OF CULTIVATION BY A WINNER OF A PRIZE.

A statement made by Hiram O. Minick, of Nemaha County, Nebraska, to whom a premium was awarded for the cultivation of a grove of not less than 1,000 trees, gives the following account of his method of cultivation:—

"The ground was ploughed in the spring, the same as for a crop of corn, and crossed out at distances of five feet by seven. The cottonwood yearling trees were procured on a sand-bar in the Missouri River, in the fall previous, and hauled in during winter. By selecting a spot on the sand-bar where the surface of the sand is but little above the water in the river, the yearling trees can be pulled out with great rapidity, probably at the rate of a thousand in twenty minutes, the operation being similar to pulling flax, and the trees can thus be taken up preserving their rootlets entire, thus securing them in the best possible condition for transplanting; and taken at this age they receive but little check in their growth by the operation. Part of my grove was planted with the spade, the operation being the same as for a hedge. Another part of the grove was planted by drawing a deep furrow with the plough, and dropping the trees at the crossings of the furrows, the roots in the furrow and the tops projecting out, and then cover by throwing another furrow-slice upon the roots and base of the stock with a plough. This left the trees leaning at an angle, say of forty-five degrees, and fearing this position would be injurious to the trees, I took the pains to place some of them carefully erect; but upon an examination of the trees, after one year's growth, no difference was perceptible in those left leaning and those straightened up, as they invariably start their growth from a bud near the base of the stock and grow erect. The portion of my grove, composed of cottonwood, contains about 3,000 trees, and was the work of two men, a boy and team, one day planting. This required one hand and horse, two days each year, to five acres of ground. The maple portion of my grove was planted by preparing the ground the same as above and dropping the seed (which had been procured from trees on the Nemaha River), in the furrow, and covering with the harrow, and cultivating as above. The seed ripens about the middle of May, and is generally very abundant. The following may be considered as a fair estimate of the cost of the grove:—Hand and team one day procuring trees, \$3; two men, boy and team employed in planting, \$5; ploughing ground, \$5; two years' cultivation of trees, \$9. Total, \$22."

TIMBER GROWING IN NEBRASKA.

(From an Article by J. W. Davidson).

"The best method of stocking our prairies with timber, is to prepare the soil precisely as you would if you were going to raise a large crop of corn. The quickest way to raise a grove is with cuttings of cottonwood or willow. I plough, drag and mark the same as for corn, four feet each way, which will contain 2,722 hills to the acre. I should plant one-half to trees, four feet one way and eight the other, making 1,631 trees, and the other in corn for two years, to pay for cultivation, and that is all the cultivation needed. I should adopt the same plan in planting acorns, hickory-nuts, white and black walnuts, soft maple, elm and ash, where the sprouts are one year old. White pine, arbor-vitæ, red cedar, European and American larch, when large enough to transplant, require more

cultivation. I estimate the cost of preparing an acre, and getting the cuttings of soft maple or ash (they can be had by the thousand along our streams) at \$3 per acre. A man can plant two and a-half acres per day. That is all the cost for ten years, except interest and taxes on land. I have 1,361 trees per acre; seven years from planting, I will cut one-fourth, or 340 trees, equal to fifteen cords of wood; the eighth year fifteen cords more; the ninth the same; the tenth year you see my profits. I should cut what is left, 456 trees. Allow four trees to the cord, so as not to overestimate it. I have several trees only ten years old, which are fourteen inches in diameter and fifty feet high; four, I think, would make a cord. Allowing six trees to the cord, we have seventy-six cords, and with forty-five cords cut before, 121 cords. At \$3 per cord, allowing \$1 for cutting, I have \$242. I contend that five acres planted to cottonwood, after a growth of seven years, will furnish one family with fuel for one stove a life-time, and sell enough to pay for the use of the land besides. I claim, after fifteen years' experience in tree-planting on this plan, which I adopted last spring, on Arbor Day, on my new farm in Otoe County, Nebraska, that the white willow is equal to soft maple for wind-breaks and fuel, and superior to all trees for rapidity of growth, as well as good for timber. Chestnut, too, is super-excellent. The climatic influence of timber is discernible in the regular attraction of rain and tempering the chilly winds of winter."

PLANTING IN NEBRASKA.

(From an Article by James Morris.)

"What shall we plant in Nebraska that will most quickly and fully meet our requirements?" Shelter and shade are our immediate and imperative necessity. To provide these we unhesitatingly recommend, first of all, our native trees, in the following order; soft maple, willow, cottonwood, buckeye, ash. The maple is raised from the seed as easily as corn; makes a good shelter when strictly planted in rows, and a grateful shade where room is given to its lateral branches. It furnishes a fuel, which, though it does not consume as slowly as oak and hickory, makes a good hot fire. The willow, objected to by many as a harbour for insects, yet offers a complete break to the keen winds, grows rapidly to a good size, and some varieties, as the white and the weeping willow, furnish good timber for fuel and manufacturing purposes. The common osier, planted upon wet spots, will pay as well as any other crop on the farm. Cuttings of all varieties are easily and cheaply secured.

"As a source of profit the raising of trees in Nebraska ranks next to the raising of stock. A quarter section planted with chestnut, spruce, larch, maple, mammoth aspen, or even inferior trees, would, in ten years, yield a satisfactory return for the investment."

CLOSE PLANTING OF COTTONWOOD.

"Judge Whiting, of Monona County, Iowa, remarked in 1869, that he had at first planted cottonwood eight feet apart each way, giving each tree sixty-four square feet of ground. They grew well, but too many branches in proportion to the amount of body of wood. He had adopted the rule of planting three feet each way, giving nine square feet to a tree, and in this order they grew tall and straight, soon shaded the ground, and in three years needed no further cultivation than thinning as became necessary, by removing alternate rows and drawing out the poles with one horse and a chain."

SUGGESTIONS ON PLANTING—(IOWA EXPERIENCE.)

Mr. Suel Foster, of Muscatine, Iowa, in a prize essay on forest-tree planting, offers the following suggestions as applicable in his State :—

“The larch is of tolerably rapid growth ; growing half-an inch or more in diameter each year for the first ten years, and the next ten years fully equal to one inch. This is in size equal to our black walnut, and it grows much better and straighter. The little trees should be bought of nurserymen, for it is a nice and particular thing to raise the larch or evergreens from seed. I would recommend to the farmers of Iowa to buy European larch at two years old at \$10 to \$15 per thousand. They should be set in nursery rows, four and a-half feet apart, and one foot in the row, so that when one row is taken out it will make a waggon-road through the grove. Larch must be moved very early in the spring, for they are among the very earliest trees to start to grow. The ground should be ploughed very deep in the fall, then ploughed in the spring, as soon as possible ; harrowed and pulverized very finely by turning the harrow bottom up the last time. Then stretch a line and set with a spade. Have a mud-hole to dabble the roots all in. While the man uses the spade, a boy can handle plants. About 2,000 will be a day's work, and will cover about a quarter of an acre. They must be carefully ploughed and hoed for two years, and if the weeds start too quick in May and June, the third and fourth years they should be ploughed.

“Cost—8,000 plants for an acre, \$80 ; setting out, \$8 ; ploughing and hoeing the first year, \$8 ; ploughing and harrowing the land before setting, \$4 ; second year, \$4 ; two years after, \$4 ; interest on the land at \$50 ; eight years, at 8 per cent. = \$32. Total cost of an acre of European larch, at eight years, \$140.

PLANTING OF THE ASH.

“Mr. J. L. Budd, now of Ames, Iowa, in a paper published in the Transactions of the Northern Illinois Horticultural Society (1867-'68), advises keeping the seeds of the ash through the winter in kegs or boxes, mixed with clean moist sand, taking care that they become neither too wet or too dry. Freezing will do no harm. The ground should be marked and prepared as for corn, and planted at the intersections, placing four to six seeds in a hill. They should be carefully cultivated, and the next spring thinned to one plant in each hill, the vacancies being supplied. By planting thus thickly, the young trees get a straight growth. At the end of six years, every alternate row north and south should be thinned out, and at the end of ten years every alternate three in each row. When twelve years old, on good soil and with proper culture the first four years, the grove would have 12,000 trees on 10 acres, averaging eight inches in diameter. By cutting the stump close to the ground, and covering with a light furrow on each side, a second growth is obtained in eight or ten years more valuable than the first.”

Professor C. S. Sargent, in speaking of this timber, says :—

“To develop its best qualities the white ash should be planted in a cool, deep, moist, but well-drained soil, where it will make a rapid growth. That the plantation may be as early profitable as possible, the young trees should be inserted in rows three feet apart, the plants being two feet apart in the rows. This would give 7,260 plants to the acre, which should be gradually thinned until 108 trees are left standing, twenty feet apart each way. The first thinning, which might be made at the end of ten years, would give 4,000 hoop poles, which at present price would be worth \$400.

“The remaining thinnings, made at different periods up to twenty-five or thirty years, would produce some three thousand trees more, worth at least three times as much as the first thinnings. Such cuttings would pay all the expenses of planting, the care of plantation, and the interest on the capital invested, and would leave the land covered with trees capable of being turned into money at a moment's notice, or whose value would increase for a hundred years making no mean inheritance for the descendants of a

Massachusetts farmer. The planting of the white ash as a shade and road-side tree is especially recommended, and for that purpose it ranks, among our native trees, next to the sugar-maple."

CALCULATIONS OF COST OF GROWING PINE TIMBER.

"Mr. Sönson, a highly intelligent Norwegian gentleman, who has made a large fortune in the timber trade, informed me some time ago that, according to a calculation which he had made, pine and spruce timber actually costs and is worth much more than the price at which it is sold. His theory is, that an acre of grown timber is worth the sum that the lowest or nominal price of wild land—say \$1 an acre—would amount to as an invested capital, drawing interest at the expiration of the period required for timber to develop. In the report on Swedish forest culture, it was shown that in the northerly parts of Sweden, two hundred years,—and on poorer soils three hundred years, are required for the pine to grow to good timber. In the south part of the country one hundred years are sufficient. It may be assumed that one hundred and eighty years are required for the growth of pine timber in the north-west part of the United States. Now, \$1 invested at 5 per cent. interest per annum, will double say, in twenty years. In forty years it will be \$4; in sixty years, \$8; in eighty years, \$16; in one hundred years, \$32; in one hundred and twenty years, \$64; in one hundred and forty years, \$128 and in one hundred and sixty years, \$256. If a thing is worth what, under favourable circumstances, it costs to produce it, then this last mentioned sum of \$256 represents the value of an acre of land originally bought at \$1, at the time pine timber will have come to maturity upon it, and this without including the charges of taxes on the land. These figures would seem to show that the pine forests of the United States are being or have been sold and consumed at a price very much below their actual value.

"In years past vast quantities of pine timber in the north-west part of the United States have been stolen from the Government, and at the very time the latter was employing agents to guard it. In very many instances, after the timber has been stolen, innocent parties, supposing from the official maps that the land was timbered land, have purchased it from the United States at private entry, at \$1.25 per acre. Interest on the purchase money, and taxes have in the course of twenty years, made such lands cost the owners from \$3 to \$4 per acre, and yet the land would not bring fifty cents per acre. Many a man has been kept poor paying taxes on such lands. Again timber-lands have been sold off in such large quantities and so rapidly as to glut the timber market.

"But a more important fact still is that no means have been taken to promote regrowth. Where hardwood timber is cut there is always a chance for regrowth by sprouts from the stumps and roots, but with pine and spruce it is otherwise; and where closely growing forests of pine and spruce are cleared without leaving seed-trees, the land may remain for ever a waste, growing every year more barren.

"In the report above referred to, it was shown that the practice in Sweden when cutting pine timber is to leave six or seven seed-trees to about each quarter of an acre. After five or six years the seed trees may be cut."

PROFITABLE METHOD OF CUTTING.

A suggestion of management in some degree comparable with European methods, was made by Peter Guillet, in a work on timber-measurement published in 1823. He says:—

"Individuals wishing to make the most of their woodlands will find it very profitable to cut their timber by sections, sparing to every acre ten or twelve of the most promising size white oaks or pines, whichever the soil will produce best; range the order of their land so as to cut a section every year. For example, say a man has 200 acres of woodland divided into sections of ten acres each, then, by cutting one section every year, he would have young timber twenty years old which makes excellent firewood, and I

should say that in common lands, wood of twenty years' growth would yield fifteen or twenty cords of firewood per acre, besides fencing timber sufficient to always keep in repair an inclosure of two hundred acres. Then the ten or twelve trees growing in reserve, will, at the end of eighty or one hundred years, furnish timber fit for shipping or staves. Where land has become useless from long cultivation, a little trouble only is necessary to make it productive and profitable to the owner. By enclosing it for a few years and encouraging the growth of the most promising young trees, which will generally spring up spontaneously, all the advantages above described will be derived from it, which is certainly the best way that worn out or sterile land can be disposed of. Such a course recommended to and adopted by individuals would not only be to their own private gain, but also of great public utility."

A NEW-HAMPSHIRE EXPERIENCE.

"The Hon. Levi Bartlett, of New Hampshire, has given in the result of his experience, an interesting illustration of the profits that might be realized from tree-planting in this State, covering a period of above fifty years. A tract had been cleared and thoroughly burned over in a very dry season, about the year 1800. It immediately seeded itself with white and Norway pines, and about twenty-five years after came into his possession. He at once thinned out the growth on about two acres, taking over half the number of the smallest trees, the fuel much more than paying the expense of clearing off. From that time, nothing was done with the lot for the next twenty-five years—having sold it, however, during that time. Upon examining it, he found that, by a careful estimate, the lot which had been thinned was worth at least a third more per acre than the rest which had been left. It was worth at that time at least \$100 per acre. He thought that had the land been judiciously thinned yearly enough would have been obtained to have paid the taxes and interest on the purchase, above the cost of cutting and drawing out, besides bringing the whole tract up the value of the two acres which had been thinned out.

"At the time when this part was thinned (twenty-five years from the seed), he took a few of the tallest, about eight inches on the stump, and forty to fifty feet high, and hewed on one side for rafters for a shed. At the next twenty-five years (fifty from the seed), he and the owner estimated that the trees left on the two acres would average six or eight feet apart. They were mostly Norway pine, ten to twenty inches in diameter, and eighty to a hundred feet high. He was greatly surprised seven or eight years after, to see the increase of growth, especially the two acres thinned thirty years before. The owner had done nothing except occasionally cutting a few dead trees. It was now the opinion of both, that the portion thinned out was worth twice as much as the other; not, however, that there was twice the amount of wood on the thinned portion, but from the extra size and length of the trees, and their enhanced value for boards, logs and timber. There were hundreds of Norway and white pines that could be hewn or sawed into square timber, from forty to fifty feet in length, suitable for the frames of large houses, barns, and other buildings. There were some dead trees on the two acres thinned at an early day, but they were only small trees shaded out by the large ones. On the part left to nature's thinning, there was a vastly greater number of dead trees—many of them fallen and nearly worthless. Of the dead trees standing, cords might be cut, well dried, and excellent for fuel. Estimates were made that this woodland would yield 350 cords of wood, or 150,000 feet of lumber per acre. Allowing that these were too large, the real amount must have brought a very large profit on the investment."

The following from Mr. Emerson, of Massachusetts, is valuable especially in its suggestions of what might be done to improve our present forests:

"On nearly every farm in Massachusetts, more land is under cultivation than can be profitably managed. Many acres now in tillage might, with great advantage be turned into forest, and the labour and manure which have been spread upon them, be used in the better cultivation of the remaining acres. All that portion of every farm which is

hilly or very stony, and all that does not readily bear good crops of corn and grass, may be, at comparatively little expense, sown with the seeds, or set with the young plants of the most valuable forest trees. The sowing or the planting should be very liberal, the young trees, when close together, protecting each other, and the poorer ones, when the plants become too close, affording excellent fuel, and serving, as they grow large, many important purposes. In this way a valuable permanent wood-lot might be added to farms, the owners of which are now obliged, at large cost, to get their fuel from other sources.

“Much is to be done for the improvement of woodlands now existing. In some cases they are managed with great care; the best means of thinning, pruning and felling, are studied and practised. But in many cases—indeed, in most instances—they are left in utter neglect. The consequences are often very visible. In the cedar swamps just spoken of, the natural seed-sowing has been so profuse, that the plants spring up thick enough to almost cover the ground. Ten or twelve may sometimes be seen on a square foot. These grow up well together for a year or two. Afterwards they seem to be struggling for existence. The growth of all is retarded—almost stopped. In a few years the strongest overtop the others, which gradually die. Still the number left living is far too great for the ground, and few of them become fine and vigorous trees. All the side branches die for want of light and air, and the topmost shoot, never sufficient to form a shapely tree, is left alone. The same thing takes place in beech groves. Ten or twenty times as many plants spring up as can be sustained. They go on together vegetating, but hardly growing. I know instances of beech woods, which have made little perceptible growth for twenty years. . . . The remedy is obvious. Every year, from the first, they need to be thinned. For the first few years the plants removed are of no value except for transplantation for fuel. Afterward they are of use in innumerable ways; the young cedars, larches, and chestnuts, for stakes and poles; hickories for walking-sticks; oaks and ashes for basket work; lever-wood and hoop-ash for whip-stocks and levers; all of the five latter for hoops. The products of the thinning will thus obviously far more than repay the labour, even if this were not necessary for the welfare of the remaining trees.”

Mr. Fay, of Massachusetts, says:—

“When I bought my place, except a few stunted red cedars at Parker's Point, and some white cedars in the swamps, there was not an evergreen tree within three miles of my house, and hardly any tree of any kind in sight of it. The woods (oak, beech and hickory) were in the dells and valleys behind the hills fronting the sea, and it was maintained that trees would not grow and could not be made to do so, in the face of the salt-laden winds from the south and south-west. The exposure was certainly great and the soil poor, and trees planted singly or sparsely, perhaps, could not have resisted it, but close planting made a shelter, and those not specially from an inland habitat (like the white maple) have done well, and seem to the manner born.

“In twenty-three years after commencing to plant, Mr. Fay has a plantation of 125 acres, of which he had sown a hundred broad-cast and planted twenty-five. The plantation consists largely of pine, spruce and larch; they have succeeded well and are generally about thirty-five or forty feet high, and a foot through at the ground. Mr. Fay says that he planted these trees as a matter of taste and experiment, but that if he had sought a market, there would have been a profit already in the sales of wood. He has endeavoured, he says, to raise a forest about him at the least possible cost of labour, and not looking much to the hurrying of the result or to count up an early profit. The land was denuded, and exhausted, and moss grown, and he took this method to cover it with verdure and restore it, believing that the wood would compensate him or his heirs sooner or later. . . . In closing his discursive remarks, he says that, considering the position of his place, exposed on the north-west to the violent winds of winter sweeping across Buzzard's Bay, and in summer to the strong breezes from the south-west, bringing salt spray from Vineyard Sound, the vigorous growth and promising appearance of his forest plantation is very encouraging to those more favourably placed. Not only may the destruction of our forests be partially remedied at a cheap cost, but the waste and sterility of our land by long cultivating and pasturing, be removed and replaced with fertility by

the simple process of nature. It is much also, to restore shade in summer and shelter in winter, by the renewal of our forests."

Mr. Morrill Allen, of Pembroke, Mass., says: "A man in Bristol County, about fifty years ago, planted a field somewhat exhausted, with acorns; when the young trees were two or three inches high he ploughed and hoed as in a field of Indian corn; the trees grew, to the astonishment of the whole neighbourhood, and in less than forty years were ripe for the axe. About a century since there was an experiment in this town in planting the white oak for ship-timber, the success of which ought to have encouraged frequent repetition. The grove was in cutting for timber thirty years since, and a man between seventy and eighty years old told me that in his boyhood he assisted in planting those trees. It is not to the existing generation so helpless an undertaking as some would represent it, to plant forest-trees, even those of slow growth. I recollect measuring the circumference of an oak tree in West Newbury, the acorn of which was planted by Benjamin Poore, who is yet comparatively a young man, and I think it measured twenty-seven inches. It is a well-proportioned, handsome tree. Had he planted at the same time fifteen acres of similar soil it would have become before now an inexhaustible wood-lot for the use of one family.

"Another gentleman, also of the name of Fay, of Essex County, commenced, in 1846, planting on his estate near Lynn, in Essex County, and in that and the two succeeding years planted 200,000 imported trees, to which were afterwards added nearly as many more, raised directly from the seed, nearly 200 acres being covered in all. The sites of these plantations were stony hill-sides, fully exposed to the wind, destitute of loam, their only covering a few straggling barberry bushes and junipers, with an abundant undergrowth of woodwax, always a certain indication, in Essex County, of sterile soil. He employed in his plantations oaks, ashes, maples, Norway spruce, Scotch and Austrian pines; but the principal tree planted was the European larch. No labour was expended on the land previous to planting, the trees, about one foot high, being simply inserted with a spade; and no protection has at any time been given them, save against fire and browsing animals. I recently visited these plantations, twenty-nine years after their formation, and took occasion to measure several of the trees, but more especially the larches. Some of these are now over fifty feet in height, and fifteen inches in diameter three feet from the ground, and the average of many trees examined is over forty feet in height and twelve inches in diameter. The broad leaved trees have also made a most satisfactory growth, and many of them on the margins of the plantations are fully forty feet high. During the past ten years about 700 cords of firewood have been cut from these plantations, besides all the fencing required for a large estate. Firewood, fence-posts, and railroad sleepers, to the value of thousands of dollars, could be cut to-day, to the great advantage of the remaining trees. The profit of such an operation is apparent, especially when we consider that the land used for these plantations did not cost more than \$10 an acre, and probably not half that amount."

Mr. Henry Ives, of Batavia, Genesee County, New York, in a communication to the New York Farmers' Club in the spring of 1876, states the result of experience in tree-planting as follows:—

"Five or six years ago I planted two acres with four-year-old seedlings of white elm and soft maple into forest rows, sixteen feet apart and three feet apart in the row. Now the best of them are twenty feet high and twelve inches in circumference, and for thinning out the rows I sell trees for more money than wheat would have brought, grown for these years, and I can continue to sell so until they are so large that I can take them for fire-wood, and I am growing a good crop of orchard grass between the rows. So that these acres in forest timber are paying as well, and are likely to pay for years to come, as any other acres on the farm. I am cutting now the second crop of wood, where the first or original timber was taken off about twenty-five years ago, and last winter 1,000 rails were taken by a neighbour from one-third of an acre of growth, besides a quantity of wood from the top, and timber not making rails. Another neighbour used nice black

walnut lumber in building a fine farm house, sawed from the trees he had helped to plant when a boy."

The late Horace Greeley, in speaking of the available opportunity for timber culture in West Chester County, remarked :—

"I am confident that ten thousand acres might to-morrow be given back to forest, with profit to the owners and advantage to all its inhabitants. It is a fruit-growing, milk-producing, truck-farming country, closely adjoining the greatest city of the New World ; hence one wherein land can be cultivated as profitably as almost anywhere else. Yet I am satisfied that half its value may be more advantageously devoted to timber than to grass or tillage. Nay, I doubt that one acre in a hundred of rocky land—that is, land ribbed or dotted with rocks that the bar or the rock-hook cannot lift from their beds, and which will not, as yet, pay to blast—is now tilled to profit, or ever will be until it shall be found advisable to clear them utterly of stone breaking through or rising within two feet of its surface. The time will doubtless arrive in which many fields would pay for clearing of stone, that would not to-day. These, I urge, should be given up to wood now, and kept wooded until the hour shall have struck for ridding them of every impediment to the steady progress of both the surface and the subsoil plough.

"Were all the rocky crests and rugged acclivities of our country bounteously wooded once more, and kept so for a generation, our floods would be less injurious, our springs unfailing, and our streams more constant and equable ; our blasts would be less bitter, and our gales less destructive to fruit ; we should have vastly more birds to delight us with their melody, and aid us in our not very successful war with devouring insects ; we should grow peaches, cherries, and other delicate fruits, which the violent caprices of our seasons, and the remorseless devastations of our visible and insect enemies, have all but annihilated ; and we shall keep more cows and make more milk on two-thirds of the land now devoted to grass than we actually do from the whole of it. And what is true of West Chester is measurably true of every rural county in the Union."

The advantages of wind-breaks are set forth by Judge C. E. Whiting, of Iowa, from his own experience as follows :—

"I have, in belts around my fields, varying from single to twenty rows of trees, mostly planted 4,356 to the acre, about forty acres of timber. The trees in these belts vary as to the time of planting ; some are eighteen years old and some only one year planted ; the greater portion are, however, from five to twelve years of age. The needed thinning of these belts furnishes all the wood that is wanted on the farm, including stakes and rails to keep the fences in repair, posts for all repairs needed, and many for new fences I annually build in extending my farm. When my walnuts get a little larger I will have all I need and many for sale. There is not a stick of needed timber on the farm, from a pea-brush, a grape-vine stake, or a binding-pole, up to a fair-sized saw-log, that cannot be had from my groves, without cutting a single tree that does not need thinning out from the groves.

"About five miles of my timber-belts are so planted that I have commenced using the standing trees for fence-posts. Where a light fence is not needed, with the use of the barbed wire, and a little change in the staple, the use of these live posts is a perfect success. Strongly and urgently as I have heretofore advocated the planting of thick belts of timber round our fields, each year but confirms me in the opinions then expressed. The land that remains will, year after year, produce larger and more certain crops than the whole field would produce without such protection. I also repeat that, in spite of all the learned discussions and scientific theorizing in regard to the cause of our timberless prairies, our cultivated forest trees, year after year, grow right along with immense rapidity, in blissful ignorance of all the reasons *why they should not grow*."

Hon. J. Sterling Morton, of eastern Nebraska, lays down his rules, and mentions his results, as follows :—

"First, the original sod should be broken and turned over in thin, evenly-laid strips. When completed, a good breaking will appear, like a vast floor of well-laid two-inch plank, painted with lamp-black. Then plant and cultivate, not to see *how much* you can manage, but *how well*. Then come trees; walnuts, cottonwoods, willows, mulberries, and elm will make the home seem civilized. Tree-planting is an avocation that barbarians never follow. Indians never adorn their wigwams with orchards, nor indulge in floriculture. There is no record of an aboriginal horticulturist in any book I have read or heard of anywhere. It may seem a long time to raise a saw-log from the walnut which lies in the palm of your hand, but the rain and frost of winter and the sunshine of summer, together with the fertile and forcing soil of Nebraska, crowd a walnut into the dimensions of a respectable saw-log in less than twenty-five years. Upon a farm where I have lived, in Otoe County, for more than twenty years, one may see black walnut trees which will make good railroad ties, and some which will do to saw up, which I planted with my own hands. . . . And again there may be found cottonwood sawlogs growing there which are more than six feet in girth, and when I first saw them they were only wandering germs, floating in the air, like down from a bird's breast. But they are adult sawlogs in 1876. These remarks, somewhat egotistical though they may be, are made for the purpose merely of impressing you, and through you the farming people, with the tree-possibilities of this State, and I only preach in this regard what I have faithfully put in practice, and the witnesses of the truth of my theories stand majestically verifying me all over the farm whence this is written to you, in the form of beautiful, thrifty, and valuable fruit and forest trees. Come down and see them, and in the hot summer days, while you rest in their shade, even their foliage will tell you in whispering with the wind how pleasant and profitable a thing it is to plant the prairie with trees."

The following shows in how short a time firewood may be procured from the planting of trees :—

"Twenty years ago cordwood sold in Nebraska city for seven or eight and sometimes ten dollars a cord, and that, too, when her population was not one-fifth what it is now; and notwithstanding the demand for fuel is at least ten times greater now than in 1857, it is a fact that good merchantable wood can be bought in our streets for from \$3.50 to four dollars per cord. The reason of this is simply from the fact that the natural groves have been protected from fire, and the artificial groves are turning out an abundance of good wood, such as the necessities of the country demand for fuel. It will agreeably surprise any one not acquainted with the fact to know the amount of timber one acre of land will produce in the course of ten years. Mr. Richard Justice, who came here (Otoe County) in 1857, and planted about ten acres of cottonwood in 1859, has one or two out-houses built from hewed logs taken from that grove, and the family have all the fuel they need. Hundreds of such cases might be mentioned throughout the eastern portion of the State, did space permit."

Mr. George Stanton, of Simcoe, Ont., writing to the Hon. H. G. Joly, says :—

"You know that this Long Point country was a great black walnut district, and on the Lake Shore there are still quite a few trees left. I have measured to-day, some five trees, and got their ages as near as I can, relying on what the owners have told me. The first tree that I saw, measured five feet eight inches, four feet from the ground, and is twenty-four years old; it is growing on very rich black sandy loam.

"The second measures five feet four inches, three feet from the ground, is thirty years old, on very light sand. The third and fourth measure twenty-three and one-half and twenty-four and one-half inches respectively, three feet from the ground, and both are eleven years old, on good clay ground, but were transplanted when young. The age of these trees the gentleman told me he was sure of.

"Number five measures seven feet eight inches, five feet above the ground, is fifty-five years old; this tree is on very light sandy soil. I mean in all the measurements, the *circumference* of the trees.

"You see from this that the soil has everything to do with the growth of a tree; the richer the soil the more rapid the advance, and, therefore, I hope that by putting my trees on rich virgin clay soil, I shall have a *return in about twenty-five years.*"

Mr. James T. Allan, of Omaha, Nebraska, writing to the last American Forestry Congress, says that there is a very rapid increase of forests in this comparatively new State, and that to-day there are forty-three millions of forest trees growing where, but a very few years ago not a tree could be seen on her wide prairies. There are thousands of stock farms in Nebraska, the owners of which are practical tree-planters. The value of groves and belts of the fast-growing poplars and white willow is well understood, and this protection for animals against driving storms, in a country where lumber is not cheap or plenty, seems to have been ordained to meet the want. But this want of lumber for all the needs of the farm will not long exist. Hundreds of groves of the earliest planted can now furnish work for the portable saw-mill, and these too, are the once despised soft woods, those of the most rapid growth which are now prepared to equal pine in durability.

The commencement of tree-planting by the Union Pacific Railway, which has yet been confined to deciduous trees of some ten varieties, and mountain evergreens about their stations, so far is successful, and will soon make these grounds objects of pleasant attraction to the thousands who are daily moving across the continent. The intention of the railway is to plant tracts of considerable extent at different points for a future tree supply, and by example induce others to plant the seeds for a crop of railway sleepers, which must be early harvested.

Mr. W. M. Pennel, of Russel, Kansas, says:—

"At least one-half of my 6,000 black walnut trees are bearing fruit this season. 3,500 box alder (ash-leaved maple) transplanted this spring, are all living; and notwithstanding the severe drought which is now parching our section of the country, my trees are making a fine growth."

Mr. John Dougall, Editor of the New York "Witness," contributed to the American Forestry Congress, such a concise and complete *resumé* of the whole subject that I insert it here:—

"The greater part of the North American continent was covered with forests when first invaded by Europeans. These forests had stood for many ages undisturbed, except by the slow decay of one generation of trees, if we may so speak, and the slow growth of another. These operations had been going on simultaneously since the creation, or since the last great convulsion of nature, and the annual falling of leaves and the gradual decay of branches and trunks had covered the earth with a vegetable mould of considerable depth.

"*A Universal Mine of Wealth.*—This mould, possessing all the elements of fertility, was an immense treasure, everywhere abounding, and tempting the settler to clear away the trees, and reap the benefit of the virgin soil. When trees were cut down, a crop, which had probably required several hundred years to grow, was reaped in a few weeks or years, thereby leaving the earth bare, and the vegetable mould was used up in a few years by continued cropping in wheat, corn and potatoes. The writer knew an excellent bush lot which produced great crops at first to be reduced in ten years to mere rocks and stones. And this process of exhausting the vegetable soil went on everywhere as fast as settlements advanced. Of course where the subsoil was good, and was turned up in part to mix with the vegetable mould, fertility continued much longer, but, in course of time,

all except prairie lands were reduced so much in fertility as to require the application of fertilizers at great expense. Had the soil at first required these fertilizers the progress of settlement would have been exceedingly slow or more probably there would have been no progress at all.

“War against Trees and its Effects.”—The labour of cutting down great trees, cutting them into short logs, and piling them into log heaps to burn, was, however, so great that a feeling of dislike to trees as the settlers’ natural enemy became general and the vengeance against them was so great that in extensive regions the land was completely bared, and thus rendered not only unsightly but unsheltered. Bleak winds had full play and droughts parched the earth. What was even worse, the clearing away of trees on the hills and mountains by the settlers, the lumbermen and forest fires, left the snow of winter exposed to the spring sun; and the sudden melting and running off of this accumulation of frozen water made dangerous floods in the streams in early summer and left those streams nearly dry in the hot season.

“Calling a Halt.”—At length the evil results of the indiscriminate cutting down of trees began to be perceived. The improvidence of previous generations was lamented, and efforts to conserve what forests were left and to plant trees gradually became popular. The first class of efforts was directed to preserving a few acres of the original forest in each farm where that still could be done, and merely thinning the trees for firewood, fencing, etc., thus leaving the smaller trees room to grow more rapidly. The grove thus preserved became one of the most necessary and valuable portions of the farm, and that without any labour of ploughing, sowing, or cultivating. It also afforded a delightful shade in hot weather for man and beast.

“Forests in the Territories.”—The preservation of the vast forests in the territories belonging to the nation attracted attention also, and laws were enacted to protect them from wanton waste. Secretary of the Interior Schurz distinguished himself for endeavouring to enforce these laws, which are very difficult of execution on account of the opportunities lumbermen have in an almost uninhabited region of cutting trees on Government land, and the frequency of forest fires kindled by careless Indians, hunters, trappers, lumbermen and settlers. These fires often do more damage to a forest in a few days than lumbermen could do in as many years, and how to prevent them is as yet an unsolved problem.

“Forestry Laws.”—The only remedy, and that only a partial one that can be suggested, for the wanton destruction of forests, is a national system of forestry laws, somewhat similar to those of France, Germany, Austria, Norway, and other European countries, which prohibit under severe penalties the injury or destruction of trees by unauthorized persons, and also the kindling of fires, or even smoking in the woods. A forest police was created to see to the execution of these laws, and at the same time providing for the utilizing of forests by gradual thinning out and selling the larger trees, so as to leave more room for the smaller ones. In this way the public forests are an annual source of revenue, and after centuries of such management they are in as good condition as they were at first.”

I will here insert, also from the Forestry Congress, the statement of a gentleman of great practical knowledge, concerning the first steps to be taken by any who may wish to make plantations from seed for themselves. Mr. D. W. Beadle, of St. Catharines, said :—

“It has occurred to me that there may be farmers who are obliged to go to nurserymen for young trees when they want to plant them either for useful purposes or for ornamentation, and if they want to plant largely they may find it impossible to get them in sufficient quantity from nurserymen, who generally confine the planting to fruit trees, and they have not grown, to any large extent, forest trees for the sake of timber. But these parties can form a nursery of these trees themselves by procuring a small piece of ground, and have it especially prepared and well manured, so that there will be strength in the soil for a few years, and then they can raise whatever kind of tree they want. The seeds of elms, maples, ashes, and of the walnut and butternut can be found in almost

any part of the Province. The important point in planting by seeds is that they should be planted as soon as perfectly ripe. Some of our trees ripen their seeds quite early. The soft maples, the *dasycarpum* and *rubrum*, and the elms, ripen their seeds in June. These maples ripen their seeds in June, and it should be gathered and sown at once so that you can get a tree of considerable growth before the winter season. The seed of the elms should also be sown at once; it should be sown in drills not deeply, but very lightly. These small seeds require to be covered with only sufficient earth to keep them moist, and they will produce plants in a very short time, and gain sufficient strength to tide over the cold season. If, however, you are not in a position to sow the seed at once, and wish to keep them till the next spring, they should be mixed with sandy soil and kept damp, yet not so damp as to cause them to germinate, and not be allowed to get dry. In this way you may preserve them with safety. If kept dry in papers some of them will have vitality in the spring, but very many of them will not germinate the next season, and the proper way to preserve them is to mix them with moist earth. But it is not true of all the maples that they ripen their seeds so early in the season. The sugar maple ripens its seeds late in the autumn, as well as the ash-leaved maple, and unless you wish to sow them in the autumn, you have to preserve them and sow them in the spring. Now come to the butternuts, chestnuts and walnuts; these all ripen in the late autumn, and, in suitable soils, may be planted as soon as gathered, and allowed to freeze and thaw with impunity, as they will not suffer therefrom, but will generate freely in the spring. But in soils which lie under the effect of alternate freezing and thawing, it will be better to mix the seed with soil in sufficient quantity to keep the seeds moist, and prevent them from moulding, and keep them until spring before planting, or they may be spread out very thin upon the ground, and covered with a sod, in which manner they will keep fresh. It is not necessary that the nuts will be subjected to frost, that is a matter of perfect indifference; the important thing is not to permit them to become dry. These trees can be grown in nursery fashion, until they attain sufficient size to be planted where they are to remain, especially the elms, maples, and ashes. The nut-bearing trees will make better growth if they be planted in the nut where they are to remain. The basswood ripens its seeds about September or October, generally late in the fall; those of the cedar also ripen in the fall. White cedar is propagated from seed, and when the seeds are to be preserved, they should be mixed with nearly dry earth, moist, but not wet."

Senator Allan gives some statistics, for the accuracy of which he vouches, concerning certain trees:—

"Elm trees taken from the woods as young trees of about six inches round the stem, and between eight and nine feet high, have attained in forty-five years a height and girth round the stem at three feet from the bottom, in several instances, as follows:—One sixty feet high, eight feet in circumference, at three feet from the ground; one sixty-five feet high, eight feet two inches in circumference at three feet from the ground; one sixty feet high, seven feet nine inches in circumference at three feet from the ground. Another elm planted about fifty years ago, a small tree from the nursery gardens, has now grown to a height of seventy feet, with a girth at three feet from the ground of eight feet six inches.

"A red oak, planted as a sapling about forty-eight years ago, is now nearly fifty feet high, and measures five feet eight inches round the stem at four feet from the ground.

"A maple of the same age is six feet five inches round the stem, and nearly sixty feet high, and two others planted within the same period, are six feet in girth at four feet from the ground, and between fifty and fifty-five feet high.

"All three of these were, when planted in their present position, young trees about six or seven feet high—just the size at which they can be most safely transplanted when taken from the woods.

"Of beech I have no record that I can entirely depend upon, but I believe one that I measured, which gave nearly four feet as the girth at about the same height from the ground, and was about thirty-eight feet high, has been planted over forty years

"A butternut between forty-seven and forty-eight years old measured six feet round the stem, four feet from the ground, and has attained a height of seventy-five feet.

"Of two ash trees planted fifty years ago, one is sixty feet high, with a girth of six feet five inches; the other about fifty-five feet high, girth a little over six feet (three feet from the ground).

"It will be seen from this memorandum that the elm has made the most rapid growth of all these trees, and the maples come next, although the ash is close upon them.

"Of evergreens (native), I can only give with certainty the white pine. Two of these—both planted fifty years ago—have reached, one a height of near seventy feet, the other a little over sixty feet. One measures six feet six inches; the other a little over five feet, at four feet from the ground."

"Mr. Beall, of Lindsay, has experimented with the black walnut. These trees, in fourteen years *from the seed*, have attained a growth of some eighteen to twenty-one inches in circumference, are twenty feet high, and have borne nuts for five years."

Mr. Caldwell, M.P.P., says:—

"Lombardy poplars twenty-two years old, measured by me, are from six feet to eight feet four inches in circumference."

Mr. Beadle says:—

"Some little blocks of forest have been planted with maple trees, with a view to their sugar-producing qualities, and some of these have attained a diameter of six or eight inches, and a height of thirty or forty feet. They have been planted some years. I do not think they received any cultivation after planting."

Mr. Roy, at Owen Sound, says:—

"Ten years ago I planted black walnut seeds, and at the present time two or three of the trees bear nuts. They are not only ornamental, but coming to be very useful trees. The diameter of two or three of them now will be as much as six inches."

Mr. Galusha says:—

"A white willow which has grown from a small cutting put in thirteen years last spring, now measures six feet two inches near the ground, forming a head on top thirty feet across."

Mr. Bucke, of Ottawa, says:—

"There has been a good deal of talk before the Commission about growing trees from the seed, but if I were going to plant trees, and particularly maples, I would go into the woods and pull up seedlings a few inches high, as I am convinced they will succeed better than by any planting of seeds. I planted a number in that way, and they are the best lot of young trees I know of. I planted them in nursery rows, about six inches apart in the row, and I have succeeded in raising a large number without losing any. I trimmed the roots before planting."

REPORT OF THE HON. H. J. JOLY.

I promised my readers at the commencement of this work, that we should return to the valuable report on the forests of Canada, issued by the Hon. H. J. Joly. We will now notice what his opinion is concerning the rate of exhaustion of Canadian forests,

and we must remember that he speaks of the whole of Canada, Upper as well as Lower. He says:

"Our forests :—Our public forests are worked by the lumbermen under a license system, entailing ground rent and stumpage dues.

"They contain a great variety of timber, but I will principally call your attention to the pine and spruce, as they form nearly all our exports to Europe, and are really the produce of our forests ; while the hardwood we export, especially the fine oak, nearly all comes, at present, from the Lake regions of the United States, as we have very little of our own left.

"For some time past, the idea has been gaining ground among men who take an interest in the future of the country, that our great pine and spruce forests are getting rapidly exhausted, and that, before long, a trade which enables us to export annually over twenty millions of dollars' worth of timber (nearly twenty-seven millions in 1874, twenty-five millions in 1875, and twenty millions three hundred thousand in 1876), will shrink down to wofully reduced proportions.

"Thinking men have begun to sound the note of alarm ; we owe it to them, but especially to ourselves, as a nation, to try and find out how far their previsions are likely to prove true.

"Apart from our timber lands, a large portion of our territory consists of fertile prairies, with rare clumps of fine trees ; of swamps without valuable timber, and of barren regions of rocky soil, with only a dwarf stunted vegetation. In those parts of Canada where the soil and other circumstances are known to be generally favourable to the growth of pine and spruce, and where a pretty accurate idea can be formed of the quality of timber already taken off by the lumberman, who can say, without continually renewed investigations, how much is getting swept away every year by our great enemy, the fire fiend ?

"Let us now try and make an inventory of the timber resources of the Dominion, beginning in the west. On the Pacific shores of the Dominion, in British Columbia, the bountiful gifts of Providence are still stored up for us, and the forests have scarcely been attacked by the lumberman. How long those treasures will last us, and what advantages we shall derive from them, depends, in a great measure, upon ourselves.

"Let us now turn eastward, and see if we can learn there, any lesson that will help us to manage our forests of the west.

"From the Rocky Mountains to the Province of Ontario there are scattered here and there, certain tracts of well-timbered land, but they are the exception. That timber will be required for the local wants of the people who are now only beginning to settle our fertile prairies, and it will never, I think, contribute to swell the bulk of our timber exports.

"The great forest of Canada, *par excellence*, is spread over that vast territory watered by the Ottawa, the St. Maurice, the Saguenay, and their tributaries, over one hundred thousand square miles in extent. Before drawing your attention more particularly to it, I will mention our remaining timber limits, that cannot compare with it either for size or resources. They are found in the Georgian Bay country ; the Muskoka and Nipissing regions ; the eastern townships of Quebec and south shore of the St. Lawrence to the Gulf ; the region on the north shore of the St. Lawrence, from the Saguenay down to the Bersimis, and, perhaps, still lower down, as far as Mingan ; and the country watered by the St. John, the Miramichi, the Restigouche, and their tributaries. Those limits, in many places, are scattered and isolated ; they have, with few exceptions (such as the Bersimis at the east, and some newly discovered pine tracts at the west, on Lake Superior), been worked for a long time, and cannot be expected to supply, much longer, any considerable quantity of first quality pine, but they still contain an immense quantity of spruce, principally in the east, sufficient for a great many years' supply, if carefully worked and protected. The spruce, unlike the pine, reproduces itself with wonderful ease, and a good spruce country, carefully worked, where you leave untouched all the trees under a certain size, say twelve or thirteen inches at the foot, can be worked and worked again after a few years' rest, I might say almost for ever.

"As a match to the timber wealth of British Columbia in the west, there have been lately discovered at the extreme east of British North America, in the recent explorations through the hitherto unknown interior of Newfoundland, magnificent forests. Let us hope that, before long, they will take their place among our Canadian forests.

"I will now return to the *Great Canadian Forest*, our great pine country, with its wonderful network of streams, and its three great arteries, the Ottawa, the St. Maurice, and the Saguenay.

"Does it begin to show signs of exhaustion? Is it possible that, in such a short time, man has been able to make an impression upon those millions and millions of acres of forest?

"If there is no sign of exhaustion, what is the meaning of the complaints that come over the seas to us, every year louder and louder, about the falling off, in quality and size, of our pine, hitherto considered the finest in the world? Are they no more than the ordinary complaints of the purchaser? I leave it to our lumbermen to answer.

"But, before they answer, I will ask them why are they compelled to go now to such enormous distances for the really superior quality of pine they used to get so much nearer home a few years ago?

"Look at the map of that great region, and you will see how little of it is now left untouched. On the Ontario side, all the most accessible tributaries of the Ottawa, the Madawaska, the Bonnechère, Mississippi, Petewawa, and others, have been worked for years; the lumbermen are now round the eastern end of Lake Nipissing, with the Matawan for an outlet to the Ottawa, that can only be reached by a land road; they are still much farther north on the shores of the Montreal River.

"On the Quebec side, they have nearly reached the head waters of all the great tributaries of the Ottawa, the Rivière Rouge, the Rivière du Lièvre, the Gatineau, with the Jean de Terre and Lake Kakebougua, and the Lac des Rapides; they are now working three hundred miles higher up than Ottawa, as the river runs on Lake Temiscamingue and the Keepawa.

"On the St. Maurice, they are as far up as Lake Manooran, on the western side of the river; its great tributaries on the eastern side, the Bostonnais and the Rivière Croche, have been deprived of the greatest part of their fine pine; it is now sought at the head waters of those rivers.

"As for the Saguenay region, it still contains a good deal of spruce, but there is only a limited extent of pine still untouched, or nearly so, south of Lake St. John, between the Meetabetchonan and the head waters of the Rivière Croche, near Commissoners Lake and Bouchette's Lake. There is a little pine left north of Lake St. John, and a certain quantity on the River Shipsha, and in the lower Saguenay on the Ste. Marguerite and Petit St. Jean, etc. As for the large rivers that flow into Lake St. John, the Chamouchona, Mistassine and Peribouca, the pine that was on the lower part of those rivers has been nearly all cut, and the remainder of their course, from their distant northern sources, is through an immense burnt up wilderness, where the vegetable soil has been consumed by fire.

"That huge tract of lumber country, between the Ottawa and the St. Maurice, that separated (or, rather, appeared to separate), the lumbermen working on those two rivers, by what seemed an inexhaustible and endless forest,—that huge tract is tapped through and through, and the Ottawa lumberman has met the St. Maurice lumberman on the shores of Lake Manooran. A glance at the map will show what that means.

"Those who think that there will never be an end to our timber may say, 'We can still go north.'

"Not very far north. From Lake Temiscamingue and the Montreal River, on the shores of which the lumberman is plying his axe at this very moment, they cannot go very far north before they strike the height of lands dividing the St. Lawrence watershed from the Hudson's Bay, and the country is generally poor and barren. There is still some fine pine there, in what quantity is not known, along the head waters of the Ottawa, but it cannot be brought down to market, at least as square timber, until very extensive and costly works have been executed for the improvement of the great Rapide des Quinze.

"Once over the heights that divide the St. Lawrence and Hudson's Bay watersheds one from another, the streams, without which timber cannot be brought to market, all run north to St. James' Bay and Hudson's Bay. Those regions are generally represented as a huge barren wilderness, with little timber and that mostly of a stunted growth. There is, doubtless, some good timber, but the idea of driving it down the Notway, the Rupert, the Harrikanaw, and all those long rivers to the shores of St. James' Bay, and taking it home down Hudson's Bay, eight hundred miles long, and through the dangerous Hudson's Strait, does not appear very practicable. Whatever timber is there may as well be considered as out of our reach for the present; in the course of time the scarcity of timber fit for export may become so great as to encourage the lumbermen to turn their efforts in that direction, but that region may safely be left out of our reckoning of the present available timber supply.

"In a very short time, since the beginning of this century, we have overrun our forests, picking out the finest pine, and we have impoverished them to a serious extent, and what makes it worse, impoverished the country too, for, owing to the force of circumstances which we shall consider later, our timber export trade has not given Canada such a return as she had a right to expect. There still remains to us a great deal of spruce and second-rate pine, which for generations to come will be in excess of our local wants, if we are careful; but the *really fine pines*, required to keep up our great timber export trade to its present standard, is getting very scarce and inaccessible, and I fear that we must prepare for a sudden and considerable falling off.

"While every one admits the great value of the timber trade to Canada, no one would complain in a new and scarcely peopled country like ours, if the finest pine forests were to disappear and make room for fine farms. But, unfortunately, we cannot comfort ourselves with such hope; the soil of the pine region is not generally favourable to agriculture, and when the pine disappears, the farmer does not often take its place.

"Men are the same all over the world; they never set much value upon the free gifts of Providence, and disregard them in proportion to their abundance—timber, fish and game have been destroyed everywhere in the same way. When what appeared to be inexhaustible becomes exhausted, it then begins to be valuable; we must pay for our experience.

"Our neighbours, in the United States, have applied to the destruction of their forests their superhuman activity and energy, and they are now worse off than we are for timber. But their eyes are being opened; the President, in his last message, has earnestly drawn the attention of Congress to the subject, and the following quotation from the last Annual Report of the Secretary of the Interior, shows how thoroughly they appreciate the gravity of the situation:—

"The rapidity with which this country is stripped of its forests must alarm every thinking man. It has been estimated by good authority, that if we go on at the present rate, the supply of timber in the United States will, in less than twenty years, fall considerably short of our home necessities.

"It is the highest time that we should turn our earnest attention to this subject, which so seriously concerns our national prosperity."

Concerning the ravages of fire in our forests, Mr. Joly says:—

"It is estimated by those who are most competent to form an opinion on the subject, that *more pine timber has been destroyed by fire than has been cut down and taken out by the lumberman*; not only is the large ripe timber destroyed by fire, but all the young trees too, upon whose growth we must depend for the restocking of our forests. It is not practicable, in our Canadian woods, to plant trees to take the place of those that are cut down.

"The difficulty of guarding against fire in such immense and distant forests as ours is enormous, and as for extinguishing it when once fairly started, *the power of man cannot do that*. It will sweep onward as long as it can find food, leaping at one bound like a giant over such rivers as the great Ottawa and Miramichi, and will only stop when brought to bay by large lakes, or when it reaches rocky or barren ground with nothing to

burn ; it will riot for weeks, until starved for want of food, or drowned under torrents of long expected rain.

"In France and Germany, where the science of forestry is brought to high state of perfection, where the forests are much smaller than ours, divided and isolated one from another, kept as much as possible free from rubbish and dead timber and all the light stuff that carries on the flames so rapidly, protected by stringent laws, strictly enforced for generations ; watched over by large staffs of foresters ; even there disastrous fires are of frequent occurrence, and they call for such an effort to suppress them, as is totally beyond our power, as the following example will show :—

"Considerable pine forests have been created within the last two or three generations in the south-west of France, and now cover large regions that were once barren heaps of sand rolled up far inland by the action of the sea. Those forests, created by man, now yielding a large and ever-increasing revenue, are highly valued and must be protected, one would think, as well as any forest can ever hope to be protected. Nevertheless, fires are frequent among them."

Speaking of the safety-strips used as a means of prevention in other countries, Mr. Joly says :—

"Even there, wherever the wind is very strong, it has been found to carry fire, such as pine cones, one or two miles, and start fresh fires."

I may remark, in reply to this, that there should be foresters in advance to watch and extinguish these. I have myself been employed at such work, almost night and day for months at a time. Mr. Joly goes on to say further that,

"Though not always sufficient, those safety-strips are, nevertheless, of great service, but their opening is scarcely practicable with us. It would entail incredible cost and expenditure on account of the great length we would have to prolong them, and the distance, and because, furthermore, the brush and timber felled down to make them would have to be removed, otherwise it would soon dry up and increase the danger instead of decreasing it. Then, to maintain their efficiency, they would have to be kept clear of a new growth. We cannot think of undertaking such a gigantic work, at least in our large and remote forests. Neither can we undertake, as they do in Europe, to clear the underbrush and to remove the deadwood and rubbish ; but if we cannot profit by these good examples, we can, nevertheless, do a great deal to prevent our forests being set on fire."

Concerning this, I may say that, in another part of this work, I have pointed out how these safety-strips might be profitably made and kept clean here. I may here remark that parties making them must not be allowed to fell timber, right and left, into the woods as if they were making a road, nor to carry brush, nor leave rail chips in there.

Concerning fires by settlers, Mr. Joly says :—

"A frequent cause of disastrous fires in the woods is the mode of clearing land now generally followed by settlers. Of course, they must have recourse to fires in order to clear wood lands, *but fire ought to be our servant, kept under continued control, not our master.*

"Wood land can be cleared with comparatively little danger from fire, and be made ready to sow earlier than by the mode now generally in use (as I know from practical experience), if the settlers will only burn the shrubs, branches, leaves and tops at once, as they cut them down. Light a good bright fire to start with, after having made a *safe place* for it, and then begin cutting away, and as you cut throw upon the fire at once ; children will help immensely with the light stuff, and willingly too. The fire once well

started, everything will burn up, the green wood with the sap running out, and the green leaves too, not only those of fir-trees, but of every hard-wood tree. As you throw in the branches the whole of the green leaves upon them catch fire simultaneously with a sudden flash, and burn up with a crackling sound as if they had been steeped in grease.

"I have often done it, frequently in wet weather. We get rid immediately of all light, inflammable material, from which the greatest danger of bush fires is to be apprehended; the larger branches and trunks of trees, if you must burn them (which you ought not) present little danger of fire in dealing with them. When you get inconveniently distant from your first fire, you light a second one and let your first one burn out; it is remarkable that those fires generally burn down to the ground more thoroughly than the carefully constructed piles that have been drying up for a whole year.

"Increased safety from fires is not the only advantage that would accrue to the settlers from the adoption of this mode of clearing wood lands. Take them as a whole, for the sake of comparing them, and this mode does not give more work than that now in use. True, you have got to convey the stuff you intend burning a little further, because one single fire, continued and replenished for some hours, will dispose of as much stuff as would have made one or two dozen average piles, but then, think of the advantage of having got all that rubbish out of the way at once, instead of having it to cumber the ground until next year, when perhaps the season will be too rainy for burning, or so dry that you will run the risk of setting fire to your own farm and the whole surrounding country. As the work is now done, even in a small clearing, no settler can keep all his fires under absolute control; he is obliged to wait for dry weather, and then he has got twenty, thirty and more fires going on at once. A sudden gust of wind, which is often produced by the intensity of the fire itself in the stillest weather, and off the fire goes, reaches the fire close by, and meets there with such encouragement as to get very soon beyond human control.

"As a further precaution against the danger to the forest arising from the clearing of lands by fire, I would recommend that the Government should confine the settlements, as much as possible, to the hardwood lands, of which there are large tracts still available. 'As a general rule (to quote the words of Mr. Allan Gilmour in answer to questions of a Committee of the House of Assembly of Quebec) it is well known that they are of much better quality for farming purposes, than those covered to any great extent with pine, while they are at the same time much more easily cleared, and will give, as a first crop, a good return, in the shape of pot or pearl ashes from the burnt timber, should the parties clearing the land choose to make them—a benefit which cannot be had from pine burnt in the process of clearing.'

Mr. Joly recommends also, "Such a study of our unsettled lands as would enable them to be classified under two distinct heads—lands fit for agriculture, to which the settlers ought to be sent, and lands unfit for agriculture, from which the settlers ought to be kept away, for their own sake as well as for the public good."

I should rather underbrush in the way Mr. Joly proposes than in any other, as I am certain that it would injure the humus of the soil far less than the ordinary way. In my clearing days, I frequently thought of trying the plan for this reason, but never actually made the experiment. It may be remarked that the reason why the settler likes to leave his brush piles lying everywhere till his chopping is done is, that he may then, after it dries in the spring, set fire to all together, which often burns up many of the logs and saves him much logging. Mr. Joly's plan, however, offers many advantages, and I do not know whether, so great is the danger of fire under the old system, it would not be well to render his plan of clearing compulsory.

Speaking of the danger of fire from lumbermen and others, Mr. Joly says:—

"Lumbermen cannot set fire to the forests in winter, while carrying on all the operations necessary for the cutting, squaring, and hauling of the timber; the danger only

exists when they drive it down streams, in the spring and often in summer. They light little fires wherever they stop on the banks of the rivers, to dry their wet clothes and warm themselves, to enliven their few minutes of rest, or, when the season gets more advanced, to smoke away the flies. Before the fire is fairly blazing, a shout is heard, and as the canoe, or the crib, or the loose logs dart past, our friends take a flying leap upon them, and down they go with the swift current, leaving the fire to itself.

"It ought to be impressed upon the foremen, as one of their most important duties, that they must look after their men carefully in the matter of fires. As the lumbermen themselves have recommended in their conventions, careful men ought to be selected in each drive to see that the fires are lighted and put out with every precaution.

"*Fishermen* are more dangerous than hunters. It is not their fault, and I do not mean to cast any aspersion on their character; for when we see them exercise, in the pursuit of their avocation, so much patience and coolness, we are bound to credit them with the sister qualities of caution and prudence; it is the season during which fishing is allowed (and during which only it can be allowed), the driest part of the summer, that makes it so dangerous.

"In granting leases for the right of fishing rivers, it would be advisable for the Government to increase the stringency of their regulations, so as to cause the lessees to be very careful how they themselves, their friends, and those under them, light and put out their fires.

"The precautions indicated in the Quebec Act, already alluded to, 34 Vict., cap. 19, especially those in section 4, for lighting and putting out of fires in the woods, are very practical and effective, and ought to be adopted and enforced everywhere. They order a careful selection of the locality where there is the smallest quantity of vegetable matter, dead wood, branches, brushwood, dry leaves, or resinous trees; the clearing away of those inflammable materials, within a radius of four feet from the fire to be made, and the total extinguishing of the fire before quitting the place. Any honest, conscientious man, with a head on his shoulders, ought to take those precautions, and be as careful of the property of others as he would be of his own. There are times in the long droughts of summer, when a man is just as guilty who throws down a lighted match in the woods, *as if he threw it in a barn full of hay.*

"The enforcement of regulations made for diminishing the danger of fire during the fishing season would not entail such expenditure as might be expected. The wood rangers and fishery inspectors would not have to watch over every square acre of forest, an army could not do that. An officer, well up to his work, would soon become acquainted with every good fishing pool where fishermen are likely to go, and would keep an eye on those spots; in his rounds he might watch, warn, and arrest careless people, if necessary."

Concerning the over-rapid cutting, in the face of the absence of reproduction, in our pine territories, Mr. Joly says:—

"The lumbermen have indicated the remedy for over-production, but have not been able to apply it. They can only apply it successfully with the help of the Provincial Governments. I respectfully maintain that it is the right and the duty of those Governments to interfere; the right, because the timber belongs to the Province—the duty, because they are answerable for every stick of that timber.

"Each lumberman is ready to admit that he (or rather his neighbour) is cutting too much timber, and that he would make more profit with a lesser quantity. It is bad enough that so much money should be wasted away in cutting down timber for no good; but if there was an inexhaustible supply of timber on the Crown lands, the Government, receiving a larger amount of timber dues than it might otherwise, would not be likely to interfere to protect the lumberman against himself.

"But our forests are getting rapidly exhausted, and their produce sacrificed; it is a loss for Canada and for the lumbermen. It is full time for the Governments to interfere. Will they do it, and can they do it, in justice?

"Of course, the first result of a decrease in the production of timber, in so far as the Government was concerned, would be a corresponding decrease in the Crown lands re-

ceipts. I won't call it the revenue, because there is something deceptive in the use of that word; we are apt to fancy that it always means (as Worcester has it) 'the income or annual profit received from lands or other property.' It is nothing of the kind in this case. We have not been spending the income or annual profit of our forests, but the forests themselves—not the interest, but the capital.

"It will be said that, without the large sums of money derived from the cutting of timber on our Crown lands, the building of railways could not have been encouraged as it has been. Nothing can contribute to the prosperity of a new country more than a railway carefully located so as to satisfy some great public necessity, without calling for sacrifices beyond the forces of the country; but while looking forward to the benefit to be derived from it, the cost must not be forgotten. We have been sacrificing our forests for the sake of our railways.

"So far as mere power is concerned, it seldom happens that a Government can control any trade as completely as our Provincial Governments can control the timber trade without laying itself open to the charge of undue interference with business. In this case, the Governments themselves are parties to the trade, since they are the owners and the sellers of standing timber.

"But if we wish to save our forests, the necessity for the prompt application of some effectual remedy is the same in every Province; the quantity of timber cut every year must be considerably reduced, if we wish to balance the yearly cutting of our forests with their annual growth. The revenue of our Crown lands must shrink, of course, but it will become a *bona fide* revenue upon which we can permanently rely.

"To sum up, the Provincial Governments can do a great deal towards checking the over-production of timber, improving thereby the tone of the timber market and preserving our forests.

"Opinions will be divided as to the best and fairest mode of action, and as to the right of the Governments to interfere. If they can alter the amount of timber dues, they can interfere most effectively, and without exceeding the limits of their power, and compel, if need be, the lumbermen to submit to such just restrictions as will preserve our forests from destruction.

"I would recommend limiting the lumberman to a maximum cut of so many thousand feet per square mile of his limits. Let it be understood, I do not mean that he should have to cut so much on each and every individual square mile, but that out of his whole limit he should not take more than at the rate of so many feet per square mile. Of course, any plan that may be adopted will require very careful consideration and adjustment."

I would myself suggest, considering what the European plan is, and its evident success in preserving the forests in perpetuity, that there the Government or the forest owner are, in fact, the lumbermen—that is, they point out the sticks that are to be cut and dictate the manner of cutting them. And being the lumbermen, and being also the owners, the forest is preserved that it may yield in future as it does to-day. I would therefore ask whether it would not be well to do one of two things, either sell the lumber tract to the lumberman altogether, with the condition that he is limited to so many thousand feet per annum, and such further conditions as shall make it his interest to preserve the tract in a reproductive and lumber-yielding state, in which case he will soon find out the best methods of forestry himself; or else let Government take entire charge, sell what sticks they choose, and see for themselves that their forests remain in a condition to replace them.

Mr. Joly speaks of the waste in making square timber, and says:—

"In making square pine, the waste of timber is generally estimated at one-fourth of the whole, and the best part of the tree, too, that part which in saw logs gives the splendid broad deals, for which Canada is famous. As it is not every tree that is sound

enough for square timber, many a pine is cut down and left to rot. There may be something wrong about the heart or in the length ; that would not have prevented it from being turned into saw logs, but won't do for square timber, and so it is condemned.

"Chips made in squaring trees considerably increase the danger of fire. In summer they get very dry and inflammable, and the way in which they are disposed in straight lines, thirty, forty, and fifty feet long, like trains of gunpowder, appears well calculated for spreading the flames through the dead pine leaves, dry branches, and moss.

"But, perhaps, they cannot do without those huge beams of timber in England? In most cases, the first thing they do, when they get them there, is to cut them up."

Mr. Joly proposes that we should cut them up ourselves, and says :—

"I think it would come cheaper to the consumer in England. Square timber is not invariably sound all through ; when cut up, unexpected flaws and rots are often discovered that were invisible from the outside. Those flaws would have been discovered if the timber had been sawn up here, and the defective parts would not have been sent across."

Mr. Joly states that the heavy loss incurred in throwing away so much of the best clear timber at the butt of the tree, in order to square it, is altogether unnecessary. It is done, he says, merely to please a few people in England who have large sawmills, and have their wealth in the very simple craft of cutting the beams up on their arrival there. To check this, Mr. Joly proposes the simple expedient of charging sufficiently high export duty on large square timber, in which case, he thinks, and apparently with good reason, we ourselves would cut up the whole log to the sizes required, send it all to England, and get as much per foot for the whole as we now do for the three-fourths. This would be better evidently for the lumberman, for the Government, for the country, and for the English consumer.

Mr. Joly notices that this regulation exists in Quebec :—"It shall be no longer permitted to cut on Crown lands pine trees measuring less than twelve inches in diameter at the stump ;" and in Quebec only ; and states that the same regulation should be enforced everywhere.

Concerning the planting of forest trees, he says :—

"It is not only in old countries, like England, France, and Germany, that new forests are planted ; it is in countries younger than Canada, in New Zealand and the Australian Colonies, for instance, where wood is not such an object of first necessity as with us, and where it is not so scarce as on our western prairies and, I am sorry to say, in some of our old eastern settlements.

"New Zealand, the Australian Colonies, and India have taken active steps for planting new forests ; and, at our doors, the United States Government are giving encouragement, by grants of land and otherwise, to those who are willing to plant trees, while a number of societies are working in the same direction. We have only, if I am not mistaken, one society in the Dominion whose only purpose is to encourage the plantation of forest trees (I do not speak of orchards). It is in the Province of Quebec, where the want of it is seriously felt ; each member binds himself to plant a certain number of trees every year. Government will have to give some encouragement, and go to the expense of making experiments on a larger scale, before any important results can be anticipated."

Mr. Joly says, with regard to the selection of trees for planting :—

"I have made experiments for several years past, and the conclusions arrived at by me are so much at variance with the general opinion of the experienced men to whom I have communicated them, that I feel a considerable degree of hesitation in making them known. However, they are founded on facts and not mere theory, and no harm can re-

sult from awakening public attention to such questions except, perhaps, exposing my ignorance and want of judgment.

"The general opinion is, that soft wood, say pine and spruce, grows much faster than hard wood, oak and black walnut, for instance. I have met with the greatest incredulity everywhere when stating that it was exactly the reverse.

"If you take the *Douglas pine* (*abies Douglasii*), which is described as one of the most rapid growers of the coniferous family, making about one inch in diameter in four years, there is not much difference to what there is in favour of our oak and black walnut; but if you take our white pine you will find that it grows about one inch in six years. I have often seen Canadian oak (*Quercus alba*) and black walnut (*Juglans nigra*) that had grown one inch in three years and a-half. As for white spruce, it is nowhere as compared with either oak or walnut or pine; men who have handled it all their lives have never thought of ascertaining what its rate of growth was; if they would only count the annual rings from the heart to the circumference, or even one or two inches long of them, they would be surprised to see what a slow grower white spruce is.

"If our black walnut and oak do really grow faster than the pine and spruce (as I think they do, and it is very easy for one who chooses to find out for himself), it is one point in their favour. A second point is that they are easier to grow from seed (nut and acorn) than pine, and that they bear transplanting better; the drying off of the top is not so fatal to hardwood trees as it is to conifers. Having sown a good many of each kind, I have often noticed that the oak and black walnut acquire strength and vigour sufficient to protect them against ordinary accidents much sooner than the young pine, which is much more brittle.

"Then, again, a forest of oak and walnut is not exposed to the same danger from fire as a pine forest is; I would refer to the chapter of fires by settlers, in the first part of this report, for proofs of the correctness of this assertion.

"As the timber of the black walnut and oak is much more valuable than the pine and spruce, as their growth is more rapid and more secure, and as they are less exposed to the danger of fire, they appear to be entitled to preference over pine and spruce for planting wherever the soil is favourable to them, as it is in the western prairies, whose fertility is well known, and where, as Professor Macoun says, all our forest trees will be easily grown.

"In dry, sandy soil, of course, the conifers must have the preference."

THE HEIGHTS OF LAND OF ONTARIO.

We will now proceed to consider, in the light afforded us by the preceding, what should be done to preserve the due proportion of forest and consequently regular summer rainfall in Ontario. My readers will have noticed of what vital importance it is to preserve the higher lands in forest. There are four elevated ridges or plateaux in Ontario. The first and nearest of these is that, well known as the Oak Ridges, north of Toronto about thirty miles, which passes round to the west, coming at Hamilton close to the Lake, going round the head of the Lake, and dying away in the Niagara peninsula. Going eastward from the same point, thirty miles north of Toronto, it gets much nearer to the Lake at Cobourg; passes on, strikes the Lake at the Trent and dies away there. This ridge being near the front, and entirely in the older settled portion of the Province, has probably long ago altogether passed out of Government hands. Much of it is by no means the best of soil, and could it have been retained in timber, and the height of the trees increased by replanting, the benefit to the Province would have been incalculable; for this long belt of forest would have met, and precipitated into rain, the moisture of the

HEIGHTS OF
LAND IN ONTARIO.

LAKE HURON

GEORGIAN BAY

LAKE ONTARIO.

LAKE ERIE

LAKE ST. CLAIR.

CARLETON PLACE

CARLETON PLACE

TORONTO

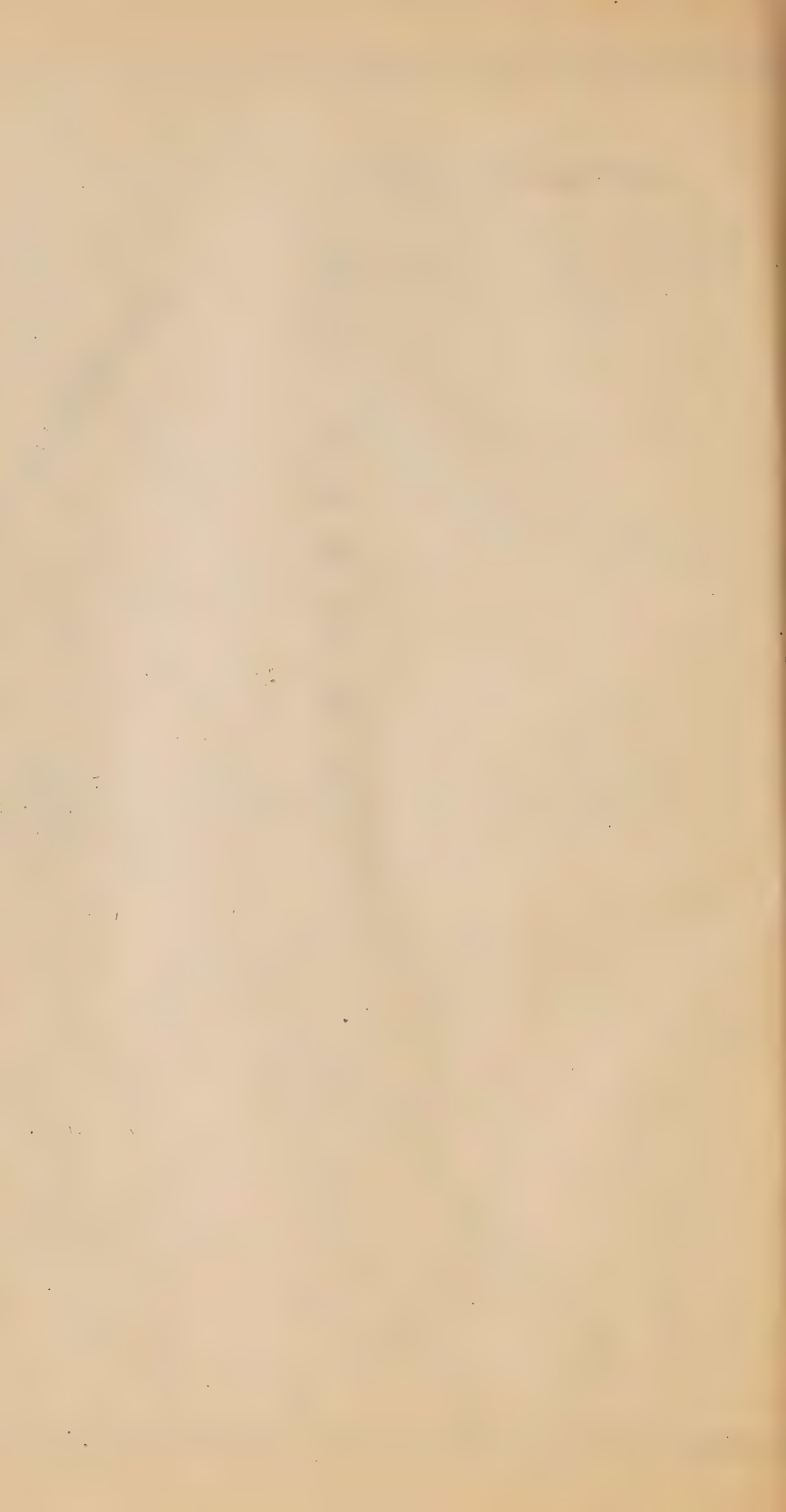
HAMILTON

MISSISSAUGA

KINGSTON

WATER SHED

THESE ARE THE THREE PRINCIPAL HEIGHTS OF LAND IN ONTARIO. THERE IS A FOURTH, THE LINE OF MOUNTAINS WEST OF THE GEORGIAN BAY, BUT THEIR INFLUENCE IS FAR LESS GENERAL THAN THAT OF THOSE SKETCHED HERE



south-west winds coming across Ontario and Erie, which rain would then have frequently and regularly fallen through the summer on the great cultivable area of land to the north, instead of passing, as it now does, largely on to the Nipissing forests. In any scheme of planting forests for the benefit of the Ontario climate, the reforestation of portions of these ridges would exercise an influence extremely valuable. I should therefore recommend that the possibilities of working in this direction should be carefully considered.

THE WATERSHED BETWEEN KINGSTON AND NIPISSING.

This is a true watershed, the rivers running both ways from its summit. The height of land extends, with a slight curve to the north, from Kingston to Lake Nipissing. To the east of this all streams flow into the Ottawa; to the west of it they flow into Lake Ontario. Much of the land on this ridge is still in the hands of Government, and, both for purposes of increasing rainfall, and preserving moisture at the source of numerous and important streams, it would be well that large masses of forest were preserved along the whole line. Along this line, if possible, hundreds of thousands, or even millions of acres might well be left in forests; for this ridge should be the preserver of fertility and source of moisture to the whole of eastern Ontario, from Toronto to the Ottawa. If this line should be allowed to become deforested, very injurious results may be expected throughout all Ontario, east of Toronto. On the other hand, if forest be maintained there, clearing can then be proceeded with along the whole north-east of the preserved forest, and this cleared region will then receive the spring and summer rain precipitated by the preserved line of forest along this watershed.

THE WATERSHED OF WESTERN ONTARIO.

This is a height of land in about the centre of western Ontario, and is best known as the locality of the great Garafraxa Swamp, which contains many thousand acres. Such of this as is not in Government hands, might, no doubt, easily be obtained, and probably, much land in the neighbourhood cheaply added thereto, and the timber on the whole reservation carefully preserved and increased by planting. This central point is a thousand feet above Lake Ontario, and from its four sides the rivers run to the Georgian Bay, to Lake Huron, to Lake Erie, and to Lake Ontario.

THE BLUE MOUNTAINS.

This is a ridge of mountains at the extreme north of our peninsula, extending from near Collingwood, past Owen Sound, and to the northern point of the promontory extending between Lake Huron and the Georgian Bay. Much of this is yet in the hands of the Government, and much of it should, if possible, be preserved in timber.

For the purpose of attracting rain in summer and spring, which would otherwise probably pass to the north on its way to the pole in the great equatorial air current, there is little reason to doubt that large masses or belts of forest, left standing on these ridges, would be more efficacious than a much larger amount left scattered through the country. Moreover, these elevations are the natural storehouses and reservoirs of moisture. The woods on their slopes were intended to hold the water of rain and snow from flooding the land when it was not needed, and to deal it out in creek, river and underground channel, as

it should be needed throughout the year. Any one who has read the valuable records, examples, and statements, collated and compiled in the preceding part of this volume; will need no further evidence, and will well understand, on being shown the heights of land and watersheds, what should be done with them. It is extremely desirable that they be, where possible, maintained in a forest state, the manner of doing which has been previously explained; and that, where disforested, they be, in preference to any other land, the scene of foresting operations.

It should also be pointed out that it has been found in every country where forestry is practised, expedient to set in operation several nurseries for the purpose of raising the seedling trees adapted for planting, of such varieties as are most suitable. These should be selected, not necessarily in any of the localities described as heights of land, but as a small portion of land would be sufficient, in any part of the country, where the soil and situation were considered most favourable for the young plants, considered with regard to their future destination. This can be well learned by consultation with those who have made such experiments, of which some are reported in these pages. It may be remarked that, although it is recommended by some experimenters to rely on the forest for seedlings, yet in other countries, where equal or greater facilities exist in that respect, nurseries are always found necessary, and would, for various reasons, probably be so here.

It would appear that, in planting or preserving these heights of land, the trees chosen should be largely of the pine variety. In the first place, their height is of great additional service. 2nd. They are evergreen, and preserve deep forest shade and shelter in summer and winter, spring and fall. 3rd. The soil of these localities is likely to resemble that found suitable to these trees in other lands. 4th. They may be relied upon for a paying return, year after year, if preserved with care, as this is the most valuable tree for commercial purposes. 5th. They will, many authorities say, grow to size fit to cut much sooner than the hardwoods of equal value. 6th. They can be, it appears, very successfully interspersed with the hardwoods, especially the beech, which would add to the plantation all the advantages of a deciduous forest.

THE GREAT FOREST TO THE NORTH-EAST.

As mentioned in the first part of this book, there is a great and largely untouched forest to the north-east of the Province of Ontario. The reason why this mass of forest has not been ere this more deeply penetrated by the settler is, that the land is not nearly so good for agricultural purposes as that in the older settled districts of the Province.

In one word, it is the Laurentian formation, an outcrop of the backbone of the world, and that backbone, unlike other bones, contains no lime; it is a granite formation, and, though there are in parts of it opportunities for obtaining lime from the gneiss rock, yet, do what you will with it, this district will never equal in an agricultural capacity (*ceteris paribus*) that based on a limestone formation. The detritus of granite is not, and in the nature of things cannot be, for agricultural purposes, in any respect the equal of the detritus of limestone. This great region is reached from Toronto at a point near Gravenhurst, and its border would be marked by a curved line from Gravenhurst to a

point about five miles east of Kingston. To the north-east of all this line is a vast mass of forest, pierced in many points by colonization roads, and interspersed with clearings along its southern edge. To this district we may add the Muskoka and the Parry Sound regions, which are, in many respects, similar. In these three are situated great pine districts, many of which have been cut over by the lumberman, while much is yet untouched and in the hands of Government. It is, it appears to me, a matter of great importance to preserve many of the pine forests in these vicinities, and that for these reasons :—

1. They are the true pine reserves of the older districts of Ontario.
2. The land whereon they stand can never yield, for purposes of agriculture, anything like the return it is capable of producing if maintained in continual pine-bearing forest.
3. If proper care be taken these great districts can, by the adoption of European methods, be placed in a state of continual reproduction, which will allow, every year, a very large amount of valuable pine to be cut without clearing the land or in any way injuring the forest capacity for production.
4. It would be far better to commence the preservation of forest areas along the present existing line of clearing than to commence similar operations much farther back. If, as is stated, the land is much better farther to the north, it would be better to renew the clearing there, so as to leave a broad belt of forest to the south of the new settlements; for a forest district to the south (without prejudice to the height of lands considerations) will attract summer showers to the cleared land north of it, while from a north forest comes little rain at the season when most needed.

PROTECTION FROM FIRE.

The great difficulty in maintaining forests in this country lies in protecting them from the ravages of fire, to which they are peculiarly subject. Our hot summers dry the edge of the forest, the cuttings left by the lumberman greatly increase the danger, the cattle of the settler dry and impoverish the forest edge for many miles, a dry season comes, fire is ignited by the clearing fires of the settler, by those of the lumberman or the hunter, or it may be at some point where the railway has touched the forest line, by a spark from a locomotive. There are two seasons when fires are likely to run—the first is during the hot months of summer, the second late in a dry fall, when the fire runs on the thick carpet of dry leaves. This last I think the more rapid of the two. I have seen it come miles abreast through the forest with the speed of a fast walker, firing every inflammable substance in its way. The terrible devastation caused by these fires when under full headway is ruinous beyond imagination. Hundreds and thousands of square miles of beautiful forest have been reduced to ashes in periods of a fortnight or even of a week. It has been well remarked by persons fully competent to express an opinion on the matter, that the fire destroys more timber in Canada than the axe. If, then, some means could be devised to check this devastation, the result would, no doubt, be extremely beneficial to the country.

The recommendation I have to make, with respect to these forests, is one based partly on the character of the soil, partly on the practice existing in India and in Europe,

and pursued there with the same intention. It is impossible to preserve the extensive Canadian forests from fire without appointing certain rangers, few or many, as may be judged expedient, whose business it shall be to carry out, in this country, as far as their numbers will allow them, the policy pursued in European countries of guarding against fire, giving warning where it occurs, and prosecuting all individuals who infringe the fire laws established by Government. To my own knowledge, the laws enacted by the Ontario Government with reference to the management of fires, their lighting and extinguishing, are carelessly observed; or even altogether ignored in the back districts through which I have travelled. I should, therefore, recommend that a certain number of men be appointed to watch breaches of these laws and institute the necessary prosecutions.

The East Indian practice to which I refer is this. In the vast Indian forests, under the careful supervision which has been established there by the Indian Government, every effort has been made to suppress or hold in check what with them is a still more dangerous enemy than with us, the ignition of the forests. The principal means recommended and used by them is, the cutting of what are called fire lines through the forests for long distances. These lines, it is recommended should be made two hundred feet wide, and be kept quite clear of brushwood, or any other inflammable matter.

In travelling through different parts of this north-eastern district of Ontario, and having in successive years passed over several hundred miles of it in different directions, I became decidedly of opinion, that the whole country was far better suited for extensive grazing grounds, interspersed with manufacturing villages, than to be given out in one or two hundred acre lots to the ordinary settler. Considering the character of the land, I am of opinion that many ordinary settlers will not be able to give it that care which alone can maintain its fertility; I fear they will, in many instances, be obliged to overcrop it, to impoverish it, and to abandon it. The granite formation, I fear, will never show the staying qualities of the limestone-founded portions of Ontario. On the other hand, I think if much of this land were given out to men of capital, who would be willing to establish large grazing farms thereon, they would be able to cover the soil with a heavy clover sod, which, with careful management might be maintained for ever.

I will, then, suggest what would be my plan if some millions of acres of this vast forest were mine, and I were desirous of preserving it from the ravages of fire. I would cut the fire protecting lines, as used in India, through and through it at different points, clearing them thoroughly from brushwood, but I should make them wider, say, a hundred yards broad, and I should suggest that paths a hundred yards broad cut through these forests, and fenced at each side, would make excellent grazing runs for cattle, if got under grass, and would operate as most effectual firebreaks. I should think that an arrangement might be made whereby graziers would gladly lease these lines, undertake to seed them with grass and use them for the fattening of their cattle, which would readily find water at the numerous streams these firebreaks would necessarily cross. A portion of the consideration paid for the use of these grazing-lines, might well be the undertaking on the part of the grazier to send a certain number of men to extinguish any fire which might arise in his vicinity. In this manner, I conceive that, by the assistance and supervision

of a small force of Government rangers, very large forests might be preserved from the ravages of fire.

In connection with the manufacturing capacities of this region of country, I would remark, that it possesses many and valuable water-courses, which would dry up were the country cleared, but which the retention of the forests will retain in full value. I would also state, that the quality of the water flowing over the granite bed, it being free from lime, is remarkably well adapted to various textile manufacture, and would suggest that large manufacturing villages and towns might find occasion for profitable existence in the heart of the large forests which, I conceive, Government should retain in this part of the country.

I would also suggest that such towns and villages will by no means lack communication with other parts of the country, as the Canada Pacific, and its connecting railways, will pass through the present wilderness near the vicinity where it is desirable these forests should be maintained.

I would here suggest that large portions of forest might be preserved, let us say, after the merchantable lumber has been carried off by the lumberman, by allotting them in free grants to persons who would undertake to maintain the land in its wooded condition.

The opinion of Mr. Ward, of Montreal, is, "To have our country remain well wooded for many years, it is but necessary to give the trees indigenous to our country leave to grow, and there will be no necessity to plant. I have no doubt but that much of the land that has been denuded of its timber would in a few years be covered with a spontaneous growth of wood, and so prevent our country from becoming an arid waste, utilizing only that portion of it that can be profitably worked." Mr. Cleveland, of Chicago remarks "A vast area of woodland is running to waste, yielding no revenue and promising nothing better in the future than firewood, of which a very large proportion is yet susceptible of redemption and conversion into timber of great value, at far less cost of time and labour than would be required for the planting and rearing of new forests." If then we give free grants of land where clearing and cultivation is desirable on condition that the land be cleared and cultivated, I should think it would be well to give free grants of forest where forest is desirable, on condition that the forest be kept in good order, that it be fenced against cattle and thinned as directed by regulations which should be laid down by a Government official of knowledge in such matters. This would give people who wish to acquire land, without being compelled to reside thereon, the opportunity of doing so, as they could hire the necessary labour and care, of persons in the neighbourhood, and they would naturally see that their employées preformed their duty properly, since that would constitute their only right to the land, and their only protection against fire overrunning it.

THE NORTH-WEST TERRITORY OF ONTARIO.

A word may well be said here as to the fact that full control of this territory is withheld from its proper possessors by the law governing the Boundary Award. It contains a large quantity of very valuable timber, comprising one of the chief timber reserves in all the North-West, so far as my information is obtainable. This

timber, in a position where it will always command ready sale, and comparatively untouched by the lumberman or settler, offers as yet a most excellent opportunity not only for procuring timber, but also for maintaining the supply. If this reserve were at once taken in hand and managed on the European or East Indian plan, those trees only cut which are of age and size, and cut so as not to injure others; and the whole forest then mapped into sections, each in charge of a competent forester, the forest could be maintained in perpetuity as good as, or better, than it now is, and a large supply of the best lumber yearly drawn therefrom.

Further hindrance of the right of control belonging to Ontario will be most prejudicial. For in the meantime the demand for lumber in the North-West will grow apace; private individuals will commence to cut; lumbering operations will be carried on by rival parties; and as soon as these operations are proceeded with on a larger scale, and with the reckless haste which probably will characterize them, fire is certain to occur, probably at many points, and, in that region of rocky timbered slopes and ridges, fully open, too, to the sweeping prairie winds, it may well be expected from what has happened in far less exposed localities, that before the boundary is found, this great forest, of priceless value*if properly used now, will be utterly lost.

THE POSITION IN WHICH FORESTS WOULD BEST AFFECT THE ONTARIO CLIMATE.

To produce their best effect on climate, three points are to be observed. 1st. To occupy the heights, firstly that they are generally of poor land well spared for that purpose; secondly, that wooded elevations preserve rain, feed springs, and continue water-courses in regular action. 2nd. They should be of considerable depth as well as length, as a thin line of forest will not by any means preserve the moist and humid atmosphere within their bounds on which their beneficial action depends. For such purposes, they should not, if it could be avoided, be less than a mile in depth from front to rear, and they had better be ten or twenty. To act as reservoirs of humidity they must be of fair extent, otherwise they will neither be able to feed the water-courses, nor to send upwards to the clouds those moist currents which, it appears by all experiment, meeting with a differently constituted atmosphere of the air, produce rain at those seasons when it is most needed. 3rd. If possible, such forests should stretch across Ontario in lines from north-west to south-east. They would then be in position profitably to intercept the south-west wind, which is the great bearer of moisture hither from the Gulf of Mexico and the tropical seas. For instance, as has been observed, the great forest north-east of Ontario does not bring much rain relatively to Ontario. Most of the rain a forest obtains will fall north-east of that forest. The exceptions are when an east or north-east wind, meeting the south-west current, produces rain, and is sufficiently strong to carry before it the rain-bringing current; but this is not to be depended on; the intention in endeavouring to preserve the forest in the line mentioned, being that the ascending currents shall meet and produce rain from the moisture-bearing winds, which are mostly south-west in reality, though often deflected and turned away by local or other influences. Of course it is not expected that Ontario can be mapped out in field and forest at this late

day. But we can know in what direction to strive here, and where forest overspreads the whole country, as in part of our territory elsewhere, very much indeed can be done.

It must always, however, be remembered that east, and even north-east winds, can and do bring rain of their own force from the Atlantic direction. But the south-west wind is the chief rain bringer. The others may be called, with reference to Ontario, local. The south-west wind brings moisture to the whole northern hemisphere.

TREES BY THE ROADSIDE.

Premiums have been very properly offered here, in a Bill just passed through Parliament, to those farmers who shall plant and maintain in growth certain descriptions of trees. The Bill refers principally to lines of trees set along the highway and the dividing lines of farms. These, or small plantations of any sort, are valuable, but by no means fulfil the functions of deep belts of forest. Their great value is, if planted over sufficient sections of country, that they preserve the land from drying winds, and in that way, if they do not, as the forest does, bring rain, they preserve the effects of rain for a much longer period. Secondly, and a very important benefit indeed, they prevent the wind from drifting the snow off the fields they enclose, and the roads bordering them. Left evenly on the ground, the snow is a vast benefit to the soil and the coming or existing plant; driven into great heaps by the wind, it not only injures both, but also renders transport over the roads difficult or impossible.

A WORD ON THE PRESENT AMOUNT OF FOREST IN ONTARIO.

It will be seen by the accompanying list that the state of Ontario, as regards possession of forest land, is as follows:—On the north-east she has a large forest, and in Muskoka and the Georgian Bay District, forests of some size. These are all the Province possesses to feed the streams, we may say, east and north-east of Toronto, and they largely at present perform that function. But the whole great peninsula to the west is destitute of most of the original forests on the elevated lands which gave her rivers water, and has little in the way of woods save the small reserves farmers have kept for themselves on their farms. As I pointed out previously, these are being rapidly used; one after another they fade away from the land and are not replaced. The accompanying lists will show exactly exactly the acreage under wood still left in each county, and when we remember that but a century ago all was forest, we shall be amazed at the rapidity of destruction; and, noticing how fast the small reserve is disappearing, we shall be quite convinced that in a very few years, unless remedial measures are successfully applied, the great peninsula of Ontario—our chief territory in a farming sense—will be to all intents and purposes, as far as climatic influences and connections are concerned, a disforested land. And I may here observe the fallacy of the statement sometimes ventured, “Oh, we cannot be in want of forests, there are so many million acres in Ontario, and of them only so many are cleared!” May I ask what this has to do with the question? Neither the woods of Keewatin nor of Muskoka can in any degree assist the farmers of the great Ontario peninsula, from Windsor on the west to Toronto and Collingwood on the east. Nor will the small patches left on each farm assist them. They are too small

and too isolated, and far too certain to vanish, to maintain the proportion of shaded land necessary for climatic purposes. But these districts, it is said, give fair crops now. They do not yield so easily as once, nor is the sky so propitious now, as the careful investigations of Dr. Bryce and Prof. Dewey, some pages back, show. But the great point is this,—they soon will, in all human calculations, suffer severely. Now, if the matter be commenced in time, we have yet space, before it be too late, to carry out what all civilized countries have acknowledged the necessity of and are to-day engaged in,—the work of making provision for a continuous forest area, and constant supply of merchantable timber.

Something can be done, and no doubt should be done, in certain parts of Ontario towards replanting our destroyed forests—destroyed in localities where forest, to improve climate and subserve agriculture, should especially have been allowed to remain. But the great opportunity which yet remains is that of preservation. This is found to be the case in India. The Government of that great country, expending yearly its hundreds of thousands of pounds sterling for preservation and replanting, has not yet planted a hundred thousand acres, while it has improved, is improving, and has to a very great extent already changed for the better, the character of many millions of acres of forest land. If we pass through much of the forest which Ontario still retains in governmental hands, we shall find, here and there, many a large expanse desolated by fire and growing up again, a brushwood choking itself to uselessness, covering a burnt and impoverished soil. We shall find great areas of forest the lumbermen have culled of pine and spruce, of ash and oak. Every here and there are the relics of their operations—the close hewn stump, and, a goodly distance therefrom, the great pile of decaying branches where the head of the tree had fallen; while the whole distance between, if round timber had been got out, shows nothing but a few scattered side limbs, but if square it is paved with immense pine fragments—short thick slabs whose deep clean cut show the force of the score-hacker's arm, and long lengths of those peculiar chips, slightly connected, thin and broad, smooth on one side, the depth and straightness of which show how deftly the handler of the broad-axe has plied his unwieldy tool; and if you come near the stump, and it has been heavy timber squared for the English market, you will find in great masses, hewn off, thrown away and rotting, as much clear timber as, sold at Toronto prices, would go far towards the whole sum the lumberman will ever get for the log. The piles of *débris* are everywhere, and form a most inflammable portion of the touchwood of a forest. Then before the strong oxen could drag the great log to the river down which it had to be floated an avenue of smaller trees had sometimes to be cleared from the way, and these likewise piled in desicating heaps, their skeleton branches protruding among the green undergrowth, like the ghastly relics of mortality on a forgotten battle-field, cumber the forest floor.

You will find many places where trees are choking one another for want of air and light, until in lapse of years some stronger one shall tower above his fellows. You will find places where hurricanes have cut their way through the forest, and the trees lie for miles, as the ranks mown down by the mitrailleuse. You will pass the solitary bush road, the trees which once grew therein chopped right and left into the forest by the makers of the track, where they lie in dry heaps for miles on miles, forming as pretty a fire-track as one could wish to see. And everywhere you will find millions of young

trees giving full promise, if spared axe and fire, of becoming trees as sturdy as any the lumberman has carried away, but nevertheless, the impression produced on you by the whole pilgrimage will be that, if no preventive measures be used, the fire which has taken so much already will sooner or later take the rest. When one compares the state of our forests with that of those in some parts of Europe, and thinks of the long avenues of fire-breaks, the forest-rangers on the watch, the careful management, the incessant thinning and replanting, the long succession of goodly trees yearly ready for the axe, and the certainty, with equal care, of such a succession for all time to come, one is apt to think it full time that some such system were introduced here.

THE POSSIBLE PROFITS.

It is to be remembered that (whether in the case of planting, or that of forest preservation), what is proposed will not be an unremunerative work. Putting altogether to one side the vast benefits to be expected in climate and in crop, there are direct returns of no small amount. For instance, most of the European reports give, after all expenses are paid, a large aggregate annual income, as does the East Indian also. Taking the opinions of scientific men, Mr. Galusha's estimate is that ten acres planted in ash and walnut will within twenty-five years produce sixteen thousand dollars in profit over expenses. Other estimates, by men who have practically experimented, give even more, especially in the case of pines. Let us take the figures of the gentleman named. He allows \$20 per acre for cultivation. Let us increase it, and say cultivation costs \$50, and that five thousand instead of ten acres are tried. The amount spent would be \$50,000 a year for five years. The return at the end of twenty-five years would be eight millions of dollars. And, all this while, the plantation would be a valuable asset upon which money could, if expedient, be borrowed. And it is to be noticed that more profit may well be expected than has been gained, for the valuable descriptions of wood will grow scarcer and dearer while, during the experiments stated (such of them as were practically carried out), these woods were purchasable at low rates. In fine, it is a work in which great climatic and agricultural advantages are sure to be gained, while, as for the money advantages arising from the sale of timber, the only reason why Canada will not immediately profit as other nations do is that she has yet much timber for use and sale without having to grow it. But the time to commence what will be a work of time, is while there is yet no actual scarcity of the article to be produced; our existing forests will give us time to grow others; and above all, there is the necessity for action to preserve from fire and waste those which now stand. The means and system used to procure fresh forests will largely tend to preserve the old in efficiency.

I will give here a few additional statements of profits from the Congress Reports:—

Mr. David Nicol, Cataraqui, Ont., says of the European Larch:—

“Experienced planters have long ago decided that the larch should be planted entirely by itself, because of its quick growth, it soon outgrows all other trees, and when scattered thinly throughout the forest, the tender top shoots are apt to be damaged by high winds; they do best when planted thickly, because they shelter one another; they are often planted as near as three feet, and sometimes as near as two feet, but I would prefer the former distance; planted at this distance, they rapidly shoot up straight, clean,

and healthy. At three feet apart, an acre contains about 4,900 ; in this state, they should be allowed to remain six or seven years, when they will have attained the height of twenty feet, if they have been well cultivated the first three or four years ; they should then be thinned for the first time by taking out every alternate row ; the thinnings make the best quality of hop-poles, worth at present about five cents apiece—2,450 poles, at five cents, brings \$122.50. Then being allowed to remain in this state about three years longer, they should have the second thinning. By taking out every alternate tree in the row, this would leave them six feet apart each way ; the thinnings are now five to six inches through, and are worth ten cents apiece for boat masts and yards, supports in mines, etc.—1,225 spars, at ten cents, brings \$122.50. After growing five years at this distance, they should be finally thinned out to twelve feet apart ; the trees will now be seven to ten inches through and over thirty feet high, can be sawed into rafters, fencing, flooring, etc. ; and are worth at least twenty-five cents apiece—612 spars, at twenty-five cents, brings \$153. Now, if we suppose that the sale of poles and spars would be sufficient to defray the expense of making and upholding the plantation, and that each tree still remaining on an acre, say fifteen years after planting, is worth only twenty-five cents, the value of 612 trees is \$153, there would be a handsome profit after allowing \$2 a year for rent, which, for fifteen years, would be \$30, and a great deal of land suitable for growing larch would not rent for more than half that amount. Now, the expenses cease, because the forest can be pastured with sheep without danger of injury to the trees ; the increase of value is now much more rapid, the annual increase of the circumference of the trees will average one and one-half inches until they nearly reach maturity, which is in about fifty years after planting. The trees will then average thirty to forty inches in diameter, three feet from the butt. Each tree will produce about 450 feet of lumber, at \$25 per thousand, \$11.25, less expenses for drawing and sawing \$2.25. It would surely not be considered extravagant to value each tree at \$9—612 trees at \$9, \$5,508, less thirty-five years' rent, at \$2 per acre ; \$70 from \$5,508 leaves a net profit of \$5,438. Be it observed that plantations of larch do not impoverish the land but rather improve it. The annual deposit of leaves gives more nutriment to the soil than is taken from it by the trees."

Mr. Hicks, of Roslyn, L. I., says of the yellow locust :—

"Hough's Report on Forestry mentions its lasting fifteen to twenty years as railroad ties, while oak lasts only five to ten years, and chestnut six to eight years. The timber is used very extensively by carriage builders, and in some instances in preference to hickory. Brewster & Co., of Broom St, New York City, using it and paying higher prices for it than for hickory.

"On Long Island, near New York City, this tree is the most valuable grown. After thirty years' growth the tree will make posts eight, ten, and twelve feet long, three to five inches in diameter, at the small end. In New York City the posts are worth, for eight feet in length, four inches in diameter, forty-eight cents ; ten feet, four and a-half inches in diameter, seventy-seven cents ; twelve feet, four and three-quarters inches in diameter, ninety-five cents ; six and a-half feet fencing posts, four inches diameter, twenty-eight cents. The trees will often cut one piece or stick twelve feet, one ten feet, one eight feet, one six and a-half feet, making \$2.48 per tree ; these are the wholesale prices. In the most famed localities, and with five or ten years' more growth, the tree will make, say one stick sixteen feet, thirty-six inches girth ; one twelve feet, thirty inches girth, and one ten feet, twenty-five inches girth, this making the tree worth many times as much, as it sells for from sixty cents to \$1.25 per cubic foot. As to value in other localities, Dr. Warder states that he is cutting trees, having a growth of twenty-four years, averaging twelve inches diameter, and sixty feet high, trees making eight to ten good fence posts, seven feet in length, six to eight inches face at the top end, trees standing 400 to the acre.

"Ezra Sherman, of Preston, Ohio, states that locust seed was sown in 1830 ; three years afterwards, the trees were planted in a grove of fifteen acres, also an avenue of 207 rods. In 1870, two-thirds of these last were cut, 180 trees making 1,500 posts, worth thirty-five cents each, or \$525 ; and Mr. Sherman says, that the fifteen acres will furnish

fence for the farm of 1,500 acres for all time, and that the pasture, together with stakes and poles for fencing, furnished from time to time, will pay as good interest as the open land would."

Mr. A. Furniss, of Indiana, speaks of the catalpa and locust:—

"Much of the cost of timber grown by cultivation depends on the price of land on which it is produced. Assuming the average price of land away from the neighbourhood of cities and villages to be fifty dollars per acre, which would be a high estimate for us in Indiana, and the cost of catalpa plants set four feet apart each way, making 2,722 per acre, at a cost of five dollars per thousand—(I grow my plants and they did not actually cost half that figure)—we have thirteen dollars and sixty-one cents for plants. But the ground must be prepared for the plants, and the transplanting is rather tedious work, hence we will allow \$11.39 for preparation of land and transplanting, making investment in plants and labour, twenty-five dollars per acre. Total investment, seventy-five dollars per acre. In Indiana lawful interest is six per cent. Now, let us compound this amount for ten years, and we have principal and interest in round numbers, \$134.30. To this we will add five dollars annually for four years for cultivation. With us the renter never pays taxes, but we will add that which would be about five dollars. To this add five dollars annually for keeping up fences, and contingencies, and we are debtor:

To cost of land and plants compounded for ten years.....	\$134 30
" cultivation four years.....	20 00
" fence, and contingencies, tax, etc.....	50 00
Total.....	<u>\$204 30</u>

"At the expiration of ten years we propose to remove one-fourth of the trees, which, if all are standing, will be 680, for which we may claim credit. Many of these by this time will make from one to two good fence posts, and at the lowest wholesale price in car loads would be worth twenty cents each. At an average of twenty cents per tree, we have \$136, to say nothing of the tops for fence stakes and fuel, all of which will be consumed on the farm. This reduces our debt to \$68.30. This we will compound for two years more and we are debtor to \$76.73. At this time, twelve years from setting, we propose to remove one-half of the whole original number, which gives us 1,360 trees. These at the very lowest estimate are worth twenty-five cents per tree, or \$340 for the lot; from this amount deduct our indebtedness, and we have a credit of \$263.27. We will now compound this for four years more, and our credit is \$332.35. Now we propose to close the account and sell the one-fourth yet remaining—680 trees. These are worth a dollar a tree; from this, however, I must deduct the interest on the land for the last four years, which is \$13.12. That leaves a net profit of \$1,049.23. But, suppose, I am told that my last lot of trees are not worth a dollar apiece. To this I reply that I know of quite a number of *catalpa speciosa* about that age, and for all such trees well grown and within twenty miles of my farm I will give a dollar each and go after them. The catalpa in University Square, Indianapolis, have been set about sixteen years, and average one foot from the ground about one inch in diameter for every year of growth, and notwithstanding they have not been crowded so as to give them the most desirable shape, yet, if the city authorities wish to dispose of them, I will take them at the above figure and be glad of the chance. Of course twenty-five dollars would not move one of them, but as this is not their commercial value, it cannot be used as a basis of calculation.

"Forty years of experience as a tree-planter has taught me that trees do not always grow where they are set precisely as desired or indicated; but, as the catalpa transplants with a remarkable degree of certainty—even growing without roots—I believe on good ground it is within the scope of practical demonstration to realize three-fourths of the result above indicated; but should one half be attained, we have \$524.61 as the return from one acre of land for sixteen years, and all this with very little labour or expense after the setting and three or four years' cultivation at the beginning, after which they require no further care."

Mr. Budd, of Iowa, who has grown trees largely, says :—

"A grove of ten acres of white ash, thinned to six feet apart, containing twelve thousand trees, at twelve years were eight inches in diameter and thirty-five feet high, the previous thinning paying all expenses of planting and cultivation. Ten feet of the bodies of these trees were worth, for making bent stuff, etc., forty cents each, and the remaining top ten cents, making a total of six thousand dollars as the profits on ten acres in twelve years, or a yearly profit of fifty dollars per acre. Mr. Everett is said to have sold twenty-three acres of black walnut, of twenty-three years growth, for twenty-seven thousand dollars, of fifty dollars per acre for each year's growth. By the way, it is well to remember that ash will grow where many trees will not.

"But the great point noticeable is that the money is secured, or rather secures itself, without labour after the first ten years. Any plantation, men of experience say, in which the trees are six feet high, and the ground so shaded that weeds and grasses cannot grow, needs no more care till the time comes to thin it for posts. As Mr. Dumbiedikes observed, the trees grow while we sleep. It may be of interest to remark how diligently Scott practised his maxim. For planting, we are told 'he had always, no doubt, entertained a strong partiality. Even in childhood,' he says, 'his sympathies were stirred by reading the account of Shenstones 'Leasowes,' and in after life there was nothing which seemed to afford him so much pride and pleasure as in watching the naked hill-sides gradually sprouting with the saplings he had planted.

"You can have no idea," said Scott to Captain Basil Hall, "of the exquisite delight of a planter; he is like a painter laying on his colours; at every moment he sees his effects coming out. There is no art or occupation comparable to this. It is full of past, present and future enjoyment. I look back to the time when there was not a tree here, only bare heath; I look around and see thousands of trees growing up, all of which, I may say almost each of which, have received my personal attention. I remember five years ago, looking forward with the most delighted expectation, to this very hour, and, as each year has passed, the expectation has gone on increasing. I do the same now; I anticipate what this plantation and that one will presently be, if only taken care of, and there is not a spot of which I do not watch the progress. Unlike building, or even painting, or indeed any other pursuit, this has no end, and is never interrupted, but goes on from day to day, and from year to year, with a perpetually augmenting interest."

RAVAGES OF FIRE.

To show what loss is being incurred by the fires which run through our forests, let us take up the report of the Commissioner of Crown Lands for 1882. There are nine reports of surveys. Let us see what they say in succession :—

"*Timber Berths North of French River.*—The greater part of my line passed through a burnt country, the fire having gone over some parts a second time. Over this burnt country all the timber has been killed."

"*Township of Dunnet.*—Over one-half of this township has been burnt."

"*Township of Hugel.*—The greater portion of this township has been overrun by fire and the timber destroyed."

"*Township of Ratter.*—One-sixth of the township has been burnt over, all the timber being utterly destroyed."

"*Township of Kirkpatrick.*—The township has been burnt over."

"*Township of Hagar.*—Bush fires have destroyed nearly all the timber."

"*Township of Field.*—No mention of fire."

"*Township of Dryden.*—The timber has been destroyed by fire."

"*Township of Wilkes.*—Not injured by fire."

In last year's report, out of fifteen surveyor's statements eleven speak of the ravages of fire.

THE PINE LUMBER REMAINING.

The latest opinions of value procurable on this head are perhaps those given by Messrs. Drummond, Little, and others who have studied this subject, at the last year's Forestry Convention. Maine and Michigan were mentioned. At Bangor, long famed for vast lumber mills, only fourteen million feet were procurable in 1877, against over a hundred million in 1856. The whole Saginaw valley, Michigan, the very home of the lumber trade, is nearly culled. What this means may be imagined when we learn that it has been cutting with mills of six hundred million feet capacity. Their lumber journals declare that in all Michigan, Wisconsin and Minnesota—the western pine States, there is not ten years' supply with the present demand. We may, I think, consider that the demand is likely to increase, perhaps to double. With this, and especially if they have a recurrence of their terrible fires, there may not be five years' supply. Concerning Ontario, we are told that Mr. Little has consulted the best authorities, and is persuaded that in Canada (5,000, Quebec; 3,500 Ontario; N.B. and N.S. 1,500) we have but ten thousand million feet of pine, while we are at present cutting a thousand million feet yearly, leaving ten years' supply. Consider this in the same light, and look at some Canadian fire statistics further on, and we may well doubt whether we have five years' supply. In Newfoundland there is little good pine left. It must be noted that a well-known lumberman, Mr. J. K. Wood, puts the amount manufactured yearly in Canada at nearly two thousand million feet, adding to pine spruce and other woods. If we count the pine timber remaining in the States, we shall find that, after Michigan, Minnesota, and Wisconsin are exhausted, say in seven years, there will probably be twice as much, say fourteen years supply, in the other States, such as the large and slowly decreasing forests still standing in Arkansas, Louisiana, and California.

In view of these facts, let us observe what will, in a very few years, be our position in Ontario, or even in Canada. We have but between five and ten years' supply. The Americans have their Southern and Pacific States as a reserve, where, though at great cost of carriage, they may obtain pine. But Ontario has no such reserve. In a few years we shall have but some districts of woodland to our north and north-east, culled of their best pine, and alternated with great sections over which the fire has swept, while the rest but wait for it to arrive, that the destruction may be complete. At one of the late forestry conventions Mr. Thistle, a lumberman and surveyor, gave it as his decided opinion that ten times as much lumber was destroyed by fire as by the axe. Let us carry this to its conclusion. We have been exporting perhaps twenty million of dollars worth yearly. What if we have been losing two hundred millions? Is it not time—would it not have paid fifty-fold—would it not still pay—to give the care to preserve our forests that Europeans give theirs? It was thought that this was a wooden country, and that there was no such danger. I would ask my readers to study the descriptions of European forestry in other of these pages. They will not be able to avoid the conclusion that, in a few years, Germany, Prussia, and other European countries will be better

wooded than Canada. We will glance a moment at what is told us of the forest when the lumbermen have culled it. Here is one description by Mr. Ward, a Canadian lumberman:—"To the uninitiated traveller through the woods, after the shantymen have taken all they think worth taking, he would hardly notice that the chopper had been there, except for seeing an occasional stump, a few chips, or the top of a tree." Now we will take another, Mr. Smith, in the "Flora of Michigan":—"The valuable trees were felled years ago, and the lumberman moved on to fresh spoils, leaving behind an inextricably confused mass of treetops, broken logs, and uprooted trunks. Blackberry canes sprang up everywhere, forming a tangled thicket, and a few scattering poplar, birch, and cherry trees serve for arboreal life, above which tower the dead pines, bleached in the weather and blackened by fire, destitute of limbs, and looking at a distance not unlike the masts of some great harbour. Thousands of such acres, repellant alike to botanist and to settler, can be found in any of our northern counties." What we had better conclude, I fancy, concerning the difference between the two, is that the second had undergone a second and yet sharper and more reckless culling, after it had passed the stage described by Mr. Ward. It is evident that the time has passed when it was a matter of choice to attend to forest preservation in Ontario. If we are to retain any, it is now an affair of immediate necessity.

In fine, if we wait longer, our forests will be gone, and can then not be renewed, except at the vast expense of time and money required in planting.

If we move energetically now, we can preserve great forests, the maintenance of which is most necessary to our prosperity, and shall also have time to plant, where no other means exist.

FOREST EXISTING IN ONTARIO COUNTIES.

(*From Agricultural Commission.*)

Prescott and Russell.:—About forty-seven and a-half per cent. of the entire area is under timber, consisting of hemlock, cedar, tamarack, beech, birch, elm, basswood, ash, balsam, pine, spruce, walnut, butternut, whitewood, dogwood, soft maple, and red and black cherry; used principally for lumber, fencing, firewood, railway ties and saw logs.

Glengarry, Stormont and Dundas.:—Probably about thirty per cent. of the entire area of these counties is still timbered with hard and soft maple, beech, birch, ash, tamarack, elm, basswood, hemlock, spruce, balsam, and some pine; used for fuel, lumber, railway ties, telegraph posts and shingles.

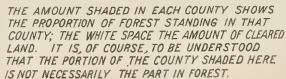
Carleton.:—About 287,000 acres of land in this county are still uncleared.

Leeds and Grenville.:—In all the townships, except South Burgess and North Crosby, which have suffered from the ravages of bush fires, there is a large amount of standing timber, consisting mainly of hard and soft woods; used for firewood, fencing, lumber, buckets and pails.

Lanark.:—About twenty-four per cent. of the uncleared land is covered with timber or bush. The timber is chiefly pine, beech, maple, basswood, ash, birch, cedar and tamarack. A considerable export trade in hardwood is carried on, and there is a large local consumption for railway ties, fencing, fuel, etc. A great destruction of pine took place from the great fire in 1870.

Renfrew.:—About forty-six per cent. of the entire area is still timbered. Red and white pine exist in large quantities. There is also an abundant supply of ash, elm, maple, basswood, spruce, cedar, tamarack, balsam, poplar, beech and hemlock. Lumbering

PROPORTION OF
FORESTS YET STANDING
THROUGHOUT ONTARIO.



extensively carried on for exportation to European and American markets. The hardwoods are chiefly used for fuel and cedar for fencing.

Frontenac:—As nearly as can be computed, about fifty per cent. of the land in Frontenac is still timbered with pine, basswood, ash, hemlock, beech, balsam, tamarack, cedar and maple; principally used for lumber, fencing and fuel.

Lennox and Addington:—Owing to the returns being in several instances obviously inaccurate, the extent of land in the counties under timber cannot be estimated. Four-fifths of Denbigh and associated townships are, however, reported to be under pine, maple, beech and cedar, and lumbering is extensively carried on. There is also a considerable quantity of timber land in North and South Fredericksburg, in Camden and in Sheffield.

Prince Edward County:—About sixteen per cent. of the entire area is still covered with timber, consisting of beech, maple, elm, cedar, oak, black ash and some pine; used for lumber, fuel, coopers' staves, fencing and building.

Hastings:—A large proportion of the acreage is still covered with timber—in some townships to the extent of seventy-five per cent.

Haliburton:—About eighty per cent. of the entire area is still under timber, consisting principally of maple, beech, birch, hemlock, basswood, elm, ash, pine, tamarack and cedar; used for lumber, fencing, railway ties, telegraph poles, shingles, bolts, saw-logs, etc.

Peterborough:—A large proportion—not far short of one half of the area—is under timber, consisting of pine, cedar, beech, maple, hemlock, basswood, tamarack, birch and ash; used for timber, fencing, firewood, shingles, bolts, railway ties and telegraph poles. Bush fires have destroyed large tracts, particularly in the township of Harvey.

Northumberland and Durham:—About eighteen per cent. of the total acreage is still timbered with hardwood, cedar, pine, hemlock, and tamarack. The former is used principally for fuel, the latter for building, fencing, and barrel staves.

Victoria:—Probably about fifty per cent. of the uncleared land is under timber, consisting of cedar, pine, hemlock, maple, birch, beech, basswood, black ash, mountain ash, balsam, tamarack, oak, and elm; used for lumber, fuel, building, and fencing.

Ontario:—About seventeen per cent. of the area of Ontario is still under timber (excepting the township of Reach, which returns no percentage). The timber consists of pine, maple, beech, basswood, tamarack, balsam, cedar, black ash, hemlock, and elm; used mainly for lumber, fuel, fences, staves, and domestic uses.

York:—About twenty-two and a-half per cent. of the area of York is still under timber, consisting of beech, maple, elm, basswood, pine, hemlock, cedar, tamarack, and ash; used for building purposes, fencing, and firewood.

Simcoe:—It is impossible to glean from the returns the total acreage under timber, but probably over one-half of the entire county area is under maple, beech, elm, basswood, tamarack, pine, hemlock, cedar, balsam, birch, ash, and oak. Lumbering operations are very extensively carried on in several of the townships, and there is a large amount of business done in hemlock bark (which is largely used within the county, and also exported for tanning purposes), and in railway ties, telegraph poles, and shingles. The hardwoods are principally used for fuel, and the soft woods for building and fencing.

Peel:—About eleven per cent. of the entire acreage is still under timber, consisting of beech, maple, hemlock, cedar, white and red oak, ash, elm, hickory, and basswood. A few pines are scattered in Chinguacousy and Toronto townships. The timber is generally used for fuel, fencing, and domestic purposes.

Halton:—About seventeen per cent. of the entire area is still timbered, chiefly with hardwood and a limited amount of pine. The timber is principally used for lumber, fencing, and fuel.

Wentworth:—Fourteen and a-half per cent. probably under timber, consisting of pine, beech, maple, elm, black ash, cedar, tamarack, oak, hickory, walnut, and chestnut; used for lumber, firewood, fencing, building, and general purposes.

Lincoln.—Exclusive of the township of Caistor, which does not report the area of land still timbered, Lincoln has over 24,400 acres still covered with beech, black ash, maple, elm, oak, hickory, and some pine; used for firewood, fencing, building, and manufacturing purposes, also for ship timber and railroad ties.

Welland.—About eighteen per cent. of the area is still under timber, consisting of beech, maple, oak, ash, basswood, elm, hemlock, poplar, birch, chestnut, walnut, and butternut; used for shipbuilding, housebuilding, fencing, and fuel.

Haldimand.—About twenty-four per cent. of the acreage is still timbered, consisting chiefly of hard woods; used for fencing, fuel, and building purposes.

Norfolk.—About twenty-four per cent. of the entire area is still timbered, and the standing timber consists chiefly of pine, oak, maple, chestnut, black and white ash, elm, and cedar; used for railway ties, lumber, fencing, firewood, and general purposes.

Brant.—About twenty-five per cent. is yet in timber of maple, beech, elm, oak, pine, cedar, basswood, tamarack, hickory, and ironwood.

Waterloo.—About twenty-two and a-half per cent of the area is still timbered with pine, oak, beech, maple, cedar, ash, and hemlock.

Grey.—About thirty-four per cent. of the land is still timbered chiefly with hardwood. Very little pine exists and only sufficient cedar for fencing purposes.

Brice.—About twenty-five per cent of the land is timbered. Maple, basswood, elm, hemlock, cedar, ash, beech and birch predominate; there is also some pine.

Huron.—About twenty-nine per cent. is covered with timber; hard and soft woods.

Perth.—About twenty-one per cent. is covered with timber, consisting of beech, elm, maple, basswood, black and white ash, pine, hemlock, cedar, birch and tamarack.

Oxford.—Seventeen per cent. under pine, cedar, beech, maple, elm, ash, basswood and oak.

Elgin.—Thirty per cent. is timbered with most of the indigenous woods excepting cedar.

Middlesex.—Thirty-five per cent. under hardwood and some pine.

Lambton.—Forty-eight per cent. covered with oak, ash, elm, beech, maple, basswood, hickory and some pine.

Kent.—Thirty-seven per cent. in oak, black and red ash, hickory, hard and soft maple, cherry, and sycamore, some black walnut, and some tulip.

Essex.—Two-thirds still under bush, consisting chiefly of whitewood, oak, ash, elm, hickory, bass, sycamore, and other woods.

Wellington.—About fifteen per cent. is still timbered with beech, maple, elm, cedar, hemlock, basswood, ash and balsam.

Ontario Forestry, (Bureau of)
Annual report

FORESTRY REPORT.

1884.

COMPILED AT THE INSTANCE OF THE GOVERNMENT OF ONTARIO,

BY

R. W. PHIPPS, TORONTO.



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1885.

To the Honourable A. M. Ross,

Treasurer and Commissioner of Agriculture.

SIR,—In accordance with the instructions of the Ontario Government, I forward my report on Forestry, for the year 1884, of the contents of which the following is a synopsis. The aim has been in this, as in former reports, to disseminate such information as shall tend to check the tendency to too thorough a destruction of the original forest, and aid, where advisable, in the formation of fresh plantations.

Last year's Forestry Report, which was largely circulated throughout Ontario, contained a view of the subject as applicable to the world in general. The present one will be found more directly to concern our own Province. It contains, in the first place, a short recapitulation of the reasons why it is of vital importance that a due proportion of forest land be preserved in every country, followed by statements from parties resident in Ontario, giving the results they have observed occur from the clearing of the forests, and their opinions as to the proper course to be taken. There will next be found descriptions from actual observation of the state of portions of the original forest left standing in settled Ontario, the manner in which it is found possible to preserve them, and the benefits to be obtained by doing so, accompanied by the evidence of numerous correspondents on the same branch of the subject, and concerning the desirability of excluding cattle from portions of such forests. There will also be found many statements, sent from various parts of Ontario, relating the beneficial effects of planting trees as wind-breaks on farms, and much from personal observation concerning the same portion of the subject, with the instances in which the best results have been obtained, and descriptions of the soils and methods of cultivation used.

A valuable portion of the work will be found the complete and minute descriptions, from the best practical tree-planters in Ontario and the United States, of the best methods of raising trees from seed, transplanting them into nursery beds, and again into their ultimate positions; with full minutiae of soils, periods, after cultivation, and kinds of trees best adapted to different earths and aspects. There are also given useful experiences of many individuals in planting young trees taken from the forest, with complete particulars as to kinds, sizes, and methods and times of transplanting.

A section is devoted to information obtained from leading men in such manufactures as the uses of Canadian timber in the workshops and factories of Ontario; the kinds necessary for each description of work, parts of Ontario whence obtained, and possible scarcity, with suggestions as to when some woods should be cut, how sized, and how seasoned. With this will also be found the prices obtainable for hard and soft Canadian timber here.

A chapter will be found containing some descriptions of the most useful trees for timber, and the most beautiful for ornament, with suggestions as to how the latter can be placed with the most agreeable effect.

The last chapter narrates a journey through certain forests of the Upper Ottawa, giving some description of the manner in which the timber trade of Ontario is carried on, with many statements of practical men in reference to the pine forests, the means to be taken to secure their preservation from fire, and the method of continuing them in a reproductive condition.

INTRODUCTION.

"Old trees in their living state are the only things that money cannot command. Rivers leave their beds, run into cities, and traverse mountains for it; obelisks and arches, palaces and temples, amphitheatres and pyramids, rise up like exhalations at its bidding. Even the free spirit of man, the only thing great on earth, crouches and cowers in its presence. It passes away and vanishes before venerable trees." — LANDOR.

In journeying lately through many of the northern and southern States, viewing the great moving panorama of valley and river, plain and mountain, city and forest, which our wonderful system of railway offers to the traveller of to-day, no contrast was more striking, none more pregnant with reflection than the difference between the deforested and the partially wooded farms on the route. Numbers of the former, numbers of the latter, were passed. The first lay, outspread and unrelieved, fields and nothing more, great parallelograms of soil seamed by fences, with a lonely house and barns in some corner, and perhaps a low, spreading orchard which did not improve matters much, for your orchard is but an exaggerated vegetable garden after all. If, here and there, some isolated trees reared their forsaken forms along the fence, they seemed but to apologize for their vanished comrades, and to say, as the wind whistled mournfully through their scanty branches, "Ah! you see what it wants; how dreary it all looks without a few more of us!"

A little further on, and how different another farm would appear! Backed on the hills in rear by a goodly reserve of timbered acres, well fenced and cared for, one could see, rank above rank, the broad, waving expanse of summer foliage; could see the great red-brown trunks of the hickory trees glancing below; could distinguish above the bushy tops of maple and beech, and the spreading masses of the basswood foliage, at that season rich with white blossoms everywhere among its broad green leaves, the whole grove giving comfortable guarantee, if cared for, of fuel and shelter, beams and boards, while the round earth turns. Then, too, the roadside fence, the long side fences as well, east, west, and south faces, would have their row of closely growing trees; a dense extended wall of fragrant cedar, or lightsome larch, or, it may be, a continuous line of clustering maple branch and stem, their multitudinous leaflets bright in the sun of early June. Screened from the wind in some quiet corner, the branches of the orchard rose. However poor the mansion, backed by such surroundings, it looked respectable, the fields rich, the farmer opulent. The comments of the travelling passengers invariably took this direction. "How much better a farm looks for the trees!" "No doubt," says another, "though he must lose some ground." "I don't know, the land is sheltered and will yield more; takes less labour too, there's more mowing and less ploughing; then see what a chance of wood he has. I'd give two thousand dollars more for this than one of those others, anyway. The man who owns a place like this is somebody. This is a residence, sir."

It is, apparently, a matter of general regret that so many young men, who might have attained great success in agriculture, leave the farm for the city. Perhaps, between this habit and the tendency to destroy every tree in the land, we may find some analogy. Where, as in some countries, farmers think more of making their farms beautiful, comfortable and agreeable dwelling-places, where they and their descendants may successively pass honoured and useful lives, than of getting from every rood of soil every dollar which can be wrung from it, there the woodland reservation is cherished as the chief pride of the farm, and foliage everywhere breaks the monotony of the dull earth line. There

“Their honour'd leaves the green oaks reared,
And crowned the upland's graceful swell.”

Trained in the views which actuated the creator of such a home, the young farmer would probably like it better than the dwellings of the crowded towns. He would be inclined to look forward to remaining there, or to making for himself elsewhere a similar one. But if, regardless of graceful and pleasing surroundings, partly moved by the remembrance of our old warfare with the forest, partly by the desire to make the whole surface profitable, we cut down every tree, is it not probable that the rising generation, considering all sacrificed to the idea of utilitarianism and acquisition, may think of turning their steps to the cities, where the first has been said to be popular, and the last supposed to be easy?

But it is now commencing to be understood that the indiscriminate clearing we have practised is injuring growth on the adjacent farms—that the grove aided to produce the fertility of the field. It is also beginning to be found throughout America that the wood lot, for growth of saleable timber alone, is sometimes the most valuable acreage on the farm. It is becoming remunerative, as well as patriotic, to preserve the woodlands. To make the facts in connection with these matters more generally known, is the object of this publication.

FORESTRY REPORT.

DANGERS OF DEFORESTING.

Throughout much of older Ontario the original forest is rapidly passing away. Many farmers of the last generation, when clearing, were satisfied if they left enough wood for their time; and their sons, in numerous instances, have left none at all. Through large sections, but ten per cent. of woodland remains. What follows in such cases is, too often, that the farmer who has yet a few acres of forest standing, being offered a hundred dollars an acre for the timber, thinks that if the wood were gone he could obtain yearly crops from the land, and buy his fuel—and lets the forest go. Then too generally, cattle, instead of being restricted to one portion of a farmer's bush, are allowed the full range of what forest he has remaining. These destroy the undergrowth, and give the wind a clear sweep through the forest below, so that every heavy gale levels more and more of our standing timber; grass gets in; the older trees decay at the top and rot at the roots, and, of course, the undergrowth being destroyed there are no young trees to replace them. The young trees and undergrowth gone, the sun gets leave to strike on the trunks of the older trees, and on the ground near their roots. Both of these are unnatural and injurious to a forest. Some few farmers here and there, aware of these facts, are preserving their woodlands; but, observing that these are but a minority, noticing the present state of our older townships, and remembering that, twenty years back, there seemed standing forest sufficient to render us secure of timber for centuries, it appears certain that, if we change not our method, another score of years will find our farming country largely destitute of woodland.

Judging by the results in other countries, and the partial experience of our own, it will be found that as fast as deforestation becomes general the little springs and rivulets now possessed by many farms will cease to flow, the reason being that the bed of the forest is naturally adapted to receive large quantities of moisture, to retain it for a considerable period, and to allow it to pass away at such times as needed to keep the springs in flow, and thereby greatly to assist the fertility of the adjacent fields.

It will also be then found—as is already being found in our front townships—that the winter's cold will be much more keenly felt, owing to the winds having free sweep over the tree-denuded fields, that it will take much more fuel to warm the houses, and much more food to maintain the cattle—that the cultivation of winter wheat and of clover, owing to the inevitable drifting of the snow over the unsheltered fields, will become less profitable, and that all outdoor work done during the winter will be conducted at greater expense and hardship, both to man and beast.

It will also be the case, should the remains of the original forests, which now dot the country be removed, that the rain and melting snow, no more held for long periods in these natural reservoirs, and flowing off rapidly as they fall or melt, must thereby occasion floods, which will, it is to be feared, annually do much greater damage along the line of our river beds than they do at present—and no little is done, even now.

It is also to be remembered that the forests, in a partially forested country, continually supply water to the atmosphere, which as continually descends in showers; and that it is in spring and summer, when these showers are most needed for the advancement of vegetation, the forests, then masses of leaves, are enabled greatly to aid in procuring such rain.

It may be well to give a paragraph stating the cause of this. The nourishment of a tree is taken in at its roots. It is carried upwards in solution, mingled with a large quantity of water, most of which water having performed its function of carrying the nourishment upwards, is thrown off in vapour through the leaves into the air. The forest thus, in Spring and Summer, is continually sending upwards great quantities of vapour, which, as soon as it finds in the atmosphere another body of vapour-charged and differently heated air, will be precipitated in rain. Now, by the great system of heat and moisture which surrounds the earth and maintains its every function, immense masses of damp and heated air are perpetually passing from the Equator to the Poles. The broad extending columns of cold and damp vapour which, invisible to the eye, rise from every forest, when they meet in sufficient quantity with these, as just remarked, change from invisible vapour to the denser vapour we call a cloud, and that again presently into rain. This process is perpetual, and gives what may be described as rain produced by local causes. Writers differ as to the manner in which the presence of woods acts on the atmosphere, but on this one point they all agree: that the air of the forest is more cool and damp than that of the open country, that so also will be that above it, and, of course, whenever a saturated and warmer current passes over, it must produce precipitation, which will fall in rain.

Let us for a moment take time here to understand why two currents of air, more or less charged with vapour of water, coming into contact, each heated to different degrees, produce rain. It occurs in this way:—

THE PRODUCTION OF RAIN.

To quote from an excellent author, “The water is not motionless either in the depths of the oceanic basin, in the solid ice, or in the atmosphere. Thanks to the always active power of the sun, to the aerial currents, the water rises vertically from the depths of the sea to its surface, becomes vaporized at all temperatures, ascends in the shape of invisible vapour through the ocean of the air, becomes condensed into clouds, travels across continents, falls again in the shape of rain, filters through the surface of the soil, passes along the strata of impermeable clay, springs up as a source or fountain head, descends by the streamlet into the river, and falls from the river back into the sea again.”

The vapour of water, as is here remarked, rises from the ocean, mingles with the dilating and arising air, and in immense quantities ascends into the higher regions of the atmosphere.

Will my readers now for a moment study this little table. It is but nine lines : —

At 14 deg. a cubic foot of air is saturated with water by the weight of 1 grain.					
30	"	"	"	"	2 grains.
41	"	"	"	"	3 "
49	"	"	"	"	4 "
56	"	"	"	"	5 "
66	"	"	"	"	7 "
80	"	"	"	"	11 "
88	"	"	"	"	14 "
100	"	"	"	"	20 "

When we thoroughly comprehend the effect of the fact stated in this table, we understand why two clouds or two currents of air more or less saturated with vapour of water, coming into contact at certain temperatures, produce rain. It occurs in the following manner :—

We will notice that a foot of air at a temperature of one hundred (the heat of a very hot day indeed) will hold twenty grains of water. If it were only at thirty degrees it would hold but two grains of water. Now let us suppose a mass of a thousand cubic feet of air at 100 degrees, and holding twenty thousand grains of water. Well, a cold current of air comes along, meets our cubic mass, and cools it down to thirty degrees. It can only hold two thousand grains now ; the cold current has served an ejection on the odd eighteen thousand grains, and they must fall out. They would fall out first into cloud, then into rain, and that is a rough sketch of the way in which rain is produced.

But we will go more slowly, and first show how a cloud is formed. Here are the words of an excellent writer on the subject, so concisely put and so clearly, that we cannot do better than copy them :—

"The *invisible* vapour of water spread through the atmosphere becomes *visible* when a decline in the temperature or an addition of moisture brings it to the point of saturation. Suppose, for instance, that a certain quantity of air at eighty-six degrees contains 478 grains of vapour of water, this air will be quite transparent. If by some cause or other this air descends to seventy-seven degrees, or receives an accession of moisture (either will do) it will become opaque. If it is done by the lowering of the temperature, a diminution of nine degrees of heat will cause 108 grains of vapour of water to be condensed and to become visible. This is what a cloud really is : vapour of water which the air, being saturated, is no longer able to absorb, and which becomes separated from it by passing into the state of small vesicles."

This is the way clouds form, and, as you will see by the following, it is but by a continuation of the same process they are precipitated in rain. If the cold current which has produced them from the warmer atmosphere continue to exert its condensing force, or if a more saturated current arrive, the process goes on, and now becomes molecular ; that is, the larger particles rapidly come together in still larger ones, the force of gravitation begins to be felt, and the whole process is described by that great meteorologist Herschel, as follows :—

"In whatever part of a cloud the original ascensional movement of the vapour ceases, the elementary globules of which it consists, being abandoned to the action of gravity, begin to fall. By the theory of the resistance of fluids, the velocity of descent in air of a

given density is as the square root of the diameter of the globule. The larger globules, therefore, fall fastest, and if (as must happen) they overtake the slower ones, they incorporate, and the diameter being thereby increased, the descent grows more rapid and the encounters more frequent, till at length the globule emerges from the lower surface of the cloud, at the vapour plane, as a drop of rain, the size of the drop depending on the thickness of the cloud-stratum and its density."

Now, if my readers have but followed these learned gentlemen through their technicalities they have grasped this plain fact:—Rain is the precipitation from the air of moisture which was more than it could, at the degree of heat to which contact with a colder stratum of air had reduced it, hold in solution. And to show how elevations, especially if wood-crowned, produce rain, any one can also easily see that if a saturated current of air arrive at a mountain chain or other height, and have to rise into the colder atmosphere above, getting colder one degree, according to the season, as they rise 200, 250 or 330 feet, as the air is the colder the higher we ascend, it must in consequence part with, as rain, much of the moisture it carries. Let us remember, too, that rain differs from cloud only in being formed of drops produced by the mutual attraction of lesser drops, which rapidly fall by force of gravitation to the earth instead of floating, as the smaller particles of moisture composing the cloud had been, in the air.

I have published this last page previously, but as it gives a very clear definition of the method of producing rain, I give it for the benefit of my present readers.

It would be well here, perhaps, to recapitulate something of the great and chief cause of rain and wind, of calm and storm. The rays of the sun, the centre of our system, beating continually down with fervid force on the great central line of the earth—the Equator, and on the whole great Equatorial belt, thousands of miles in width, hundreds of thousands of square miles in area, cause to arise, in constant vapour, from the great ocean surface rolling within that immense space, a mass of moisture and of mingled air, wide as the broad extended waters from whence it comes. Everywhere there it is rising to the skies, it flows off, north and south to the poles, and is the warm and moist Equatorial current. On the way it parts with much moisture, at the poles with much, and comes back from the poles to the Equator, now called the Polar Current, cold and dry, till at the Equator it rushes again into the vacuum formed by the rising Equatorial column of air and moisture, rises aloft once more and seeks the poles again. These, from the Equator to the Pole and from the Pole to the Equator again, are the two chief winds in the world. The rest are but modifications of these. These two do not continue in unmixed career—they rise and fall—they meet and separate; immediately above us on one day, may be the warm and moisture-saturated current coming from the Equator, another day, and it may be replaced by a colder and dryer atmosphere passing southward from the Poles. This forms the great general system of distribution of moisture over the earth, as the meeting and intermixture of these vast moving masses of differently heated air and vapour must produce precipitation and rain. All over the earth, by this system, rain falls. It is found, however, that local circumstances greatly modify its action. A sandy desert is said to drive away rain, that is, the refraction from its surface prevents rain from being formed near it. A forest is said to attract rain, that is, as stated before, it assists, by the vapour ascending, in its formation.

Of all the local causes which tend to produce rain, forests are by far the most beneficial to the cultivator; for the great but invisible columns of cold and moist air which arise from them are sent upwards when rain is most beneficial to the farmer—in the Spring and Summer months—in Spring, because the forest bed is cold and wet with the remains of snow and hoarded rain, and yet evaporating rapidly—in Summer, because every full formed leaf is transpiring vapour from its thousand pores. “If,” says a scientific writer, “the vaporous clouds arising from forests were coloured, the size of the forest below would be as nothing to the bulk-expanding columns which would be visible above.”

Another cause of great injury to a deforested country is, most undoubtedly, the great amount of fertile soil carried away yearly by the rapid passage of bodies of water across the surface. This is called, scientifically, aqueous denudation, and is the immediate result of doing away with too much of the forest. The unrestrained waters continually carry the valuable constituents of the soil—the chief riches of the country—to the rivers, the rivers to the lakes, the lakes to the ocean. Wherever the hand of man, after clearing as much of the woodland as should properly be changed to fields, and devoted to agriculture, has greedily stretched further still, and recklessly dislodged the last barriers of nature against denudation, the remaining and interspersing woods, it has gathered the forbidden overplus of the manna, which will assuredly turn to death and corruption in the store. The strength of the soil is the life of the nation; if the former be impoverished the latter must decay. We may build our tower and fence our vineyard, but if the woods go no fence will keep our property; it also assuredly goes, though almost invisibly. With each torrent of rain, as the waters flow rapidly over the land, a last column of our richest possessions moves to the sea. It is shallow, but it is a thousand miles broad, and next week goes another, and another. This is one chief reason why many fields, once rich, now need manure; and why many lands, once gardens, are now sandy wastes past all manuring.

From these reasons, it has been found in many countries that deforesting has been followed, sooner or later, by barrenness. In Spain, in France, in Russia, in Germany, in all the bordering countries of the Mediterranean, of which the richness and fertility formerly gave them many millions of population—gave them crowded harbours, vast fortified cities, great fleets and immense armies, the same process has occurred. Let us mark for a moment the difference of race. The Caucasian mind long since saw the process and its results, grasped the problem and solved it. Much of Europe, France and Germany especially, have for centuries cared for their forests; most of Europe is now caring for them, and where it is done fertility remains. It is not so with the Asian shores, nor with the African regions once celebrated in history. In countries where, at the command of Xerxes, great navies were built, long travel would be necessary to find keel, ribs and planking for half a dozen galleys. The forests are gone, and great areas of cultivable land which lying adjacent, fed with moisture and preserved in fertility by the proximity of these forests, sent him many an army, are sterile wastes which scarce could find a regiment for the field. A remarkable instance—and in the country of which alone we possess sacred historical records—exists in Palestine. When it was rich and fertile, flowing with milk and honey, its hillsides and its mountains were forest lands. The day of the cedars of

Lebanon was the day of the grapes of Eschol. The vaileys had been cultivated, the hills left in forest. But now all is changed. The Jordan, then a noble river, is now a muddy and shallow stream; the fertile vaileys are wastes; the tree-clad hills are bare and rocky eminences. All over the world are similar instances, and of much later day, and accomplished in much shorter time.

I do not know that, of all in Europe and America who have noticed these facts, any have discovered the *modus operandi*—the method of operation of the injury done. It is hard to calculate on causes which are under earth, hidden from our view by gravel bed and sandy strata,—by rock and boulder and clayey subsoil,—and alluvial earth covering over all. Let us try and reason it out by observing that which we do know. See yonder rose-tree in the flower-pot. If the flower-pot have no opening below, and we give it a generous watering, the overplus moisture cannot leave the soil, the earth, over-saturated with wet, remains so, the rose-tree flourishes no more. Or let there be an opening, and forget to water; the dried-up earth refuses to nourish the exhausted roots, the rose-tree dies. But allow the means of escape below, and nourish with occasional and well-timed waterings above, and your rose-tree, it may well be, will flourish in fervid life, a pyramid inverted of glossy green with bud and flower among.

Let us compare this with the fields. While the forests remain in due amount, diminutive underground watercourses run everywhere beneath them. If you have ever dug a railroad cutting through wood and field, you will find under the wood many a spring. Under the field, unless you dig deeply, you will find but very few. And you will find it general that while the country is forested you will get well water at but a few feet in depth; when it is partially cleared, you must go deeper; when fully cleared, very deep indeed.

The country partially cleared may be, I should say, likened to the occasionally watered and well-tended flower-pot. The fertilizing showers of spring and summer will, from the proximity of the trees, be frequent and nourishing. The overplus moisture will at once be carried away by the underground channels, still for that purpose existing sufficiently near the surface: vegetation will flourish, and the fields yield a generous return. As with the well-tended flower-pot, the regular succession of moisture and heat has been bestowed.

But when a country is almost deforested, the original underground channels near the surface little used, must of necessity largely close. Rain, then falling, will have a great and still increasing tendency to flow away over the surface, carrying with it in solution the richest part of the soil. Added to this, these rains will be heavy and flood-producing. The gentle and frequent spring and summer showers, which the woods should attract, will seldom be there. The land will not yield so rich nor so easily produced a return. To farm will be a labour more and more slavish, for the farmer will be working against Nature. He will have interrupted the course of the means by which she aids him in his toil.

In Ontario we have made advances already too rapid in this direction. Let us consider the best course in which now to proceed. On the settlement of Ontario, the first object necessarily was the clearance of the woods. Until this was done, no land could

be obtained for farming purposes; but so much has now been cleared, that it is time to look around and consider carefully our future course. In some districts little over ten per cent. is left, in many but twenty, while others far from the frontier have of course much more. It is everywhere allowed that, in view of the only too probable approaching scarcity of wood for fuel, building, lumber and manufacturing purposes, it would have been well if, at the first settlement of the country, certain tracts or portions had been set apart for timber and left therein for the general benefit. This cannot now, except in counties remote from the frontier, be done. The country is largely in the hands of those who have purchased it from Government, and the reserves of timber, such as yet remain in the settled portions, are principally in the hands of private owners. Let us observe whether it would not be for the benefit of these private owners to maintain a portion in forest.

All through settled Ontario, among the woodlands we still possess, are still found red oak, hard maple, rock elm, birch, cherry, basswood, ash, soft elm, and other valuable woods. Many of these are not obtainable in anything like such quantity or quality, if we go much farther back; much of them, however, still remain in older Ontario and in the hands of private owners. It is these which we draw on year after year for a number of valuable industries hereafter to be mentioned. It is now time, while we still have these reserves, to think whether there be no plan by which they can be made continual.

Although, in many localities in Ontario, are still procurable most of the valuable woods which are used in our manufactures (for one, in the making of all those descriptions of agricultural implements, which are now so indispensable to the agriculturist), yet these are going so rapidly that a leading manufacturer says, "All kinds of hardwood are becoming scarce, and in a very few years, at the present rate of consumption, will have to be obtained from without the Province."

It must be noticed that these are not becoming scarce at all so much in consequence of their use by the manufacturers, but as a result of the steady clearing which has for many years been going on throughout Ontario. As, in a thousand localities forests have been cleared away, which, if left standing till now, would have sold for ten times the profit of all the crops the land has ever produced; so in many places to-day farmers in the process of clearing, are burning up timber which would, in a few years, have become very valuable, which is, in fact, valuable now if it could be brought to the localities where needed. Indeed, in some cases, it is valuable where it stands, but its owners are not aware of the demand for it.

The process of clearing commences in what are called the back-woods. Wood, except, indeed, it may be pine, which the lumbermen have the right to carry off, is of little value there. All the rest is chopped down, cut into fourteen-foot lengths, if not very heavy timber, hauled together by oxen, piled in heaps and burnt. About half the land is cleared, and the settler looking around him, still seeing forests everywhere, thinks that whatever happens wood will never be scarce in that part. This is as yet in the backwoods, but soon the name is no longer applicable. The farmer on a two-hundred-acre lot may perhaps have saved forty acres of bush, but he is not likely to have more. It is by this time no longer the backwoods, they are far away, and the same process is going on in them; but here in the townships we commenced to describe, the forty acres

or so left rapidly diminish ; the lands are sold and must be cleared ; sons are left portions ; they are wooded, and before they can be used they must be deforested. Wood becomes scarce ; forests through which cattle are allowed to range, blow down ; the farmer thinks he had better clear them up and have them in crop ; and, by degrees, the township is as the front townships, with its woodland diminished to ten per cent. of the acreage, and scattered here and there in uncared for and irregular portions. Fuel now becomes scarce ; the farmer is offered a high price per acre to allow the cord-wood to be taken from off the portion he still retains uncleared ; he accepts it ; the remaining forests diminish more and more ; the country becomes bleak, and is on the way to become unfertile.

Throughout Europe it is found much more valuable to allow a certain portion of forest to remain as forest. The oak, the beech, the ash, the pine remain there, growing into value. The owner of the woodland can sell every year a number of valuable trees without injuring his forest land. The forest remains as forest, the trees which are taken away merely leave room for other and younger trees to fill their places ; and, without the trouble of ploughing, harrowing, sowing, manuring, or summer fallowing, the portion of forest he retains yields him every year a considerable income.

I would wish now to suggest to the farmers of Ontario a method whereby they themselves may in future obtain such an income with as little labour. As I have pointed out, timber of all sorts is likely soon to become scarce in Ontario. If our farmers, say on 200 acre lots, can preserve twenty to forty acres of woodland, and on 100 acre lots half that amount, it would give them the opportunity of leaving a certain portion of bush in which their cattle might wander, and yet allow them to retain a tolerable reserve for purely forest purposes. These portions of original forest, or even a part of them, if secured for that purpose, would act as nurseries of timber trees, far more economic and efficient than any field-planting can secure us. In such portions of these as are fenced against the inroads of cattle, the forest trees—pine, maple, ash and elm—in fact, all the most valuable sorts, will seed themselves and form a rich undergrowth, which preserves the older forest above in more ways than one—it keeps the original forest soil about the roots of the larger trees, thereby strengthening their hold on the ground ; it closes up with a mass of verdure the lower interstices of the forest, thus preventing the otherwise unimpeded rush of the winds ; thirdly, towards the forest edge it produces trees grown in the sunlight which, firmly rooted as their nature is when grown in that position, stand as a barrier to defend the rest. Any portion, therefore, of the original forest well fenced will, in all likelihood, reproduce itself continually in its former strength, and shortly be in a position to furnish yearly to the husbandman, from the full-grown trees, a constant supply of excellent timber ; while the benefits of continuing throughout the Province many such patches of forest, dense in underwood and retentive of moisture, can hardly be over-estimated.

It may be remarked that the process is as follows : Where an undergrowth is allowed to flourish, cattle being excluded, grass does not overspread the ground, and the seeds, falling from the trees, continually take root in the rich and moist forest soil. The attempt of the strongest saplings to overtop the undergrowth projects them upwards, they overtop it, and, by this time young trees of perhaps fifteen feet in height, their next effort is to rise to the sunlight above the forest shade which embowers all. Thus we

obtain, in a very few years, a high straight slender trunk which, once reaching the light above the forest roof, soon thickens into valuable timber. This is the forcing process of the forest, ready, if we will but allow it, to give us a continuous succession of valuable trees, without the labour of sowing, planting or cultivating.

I know a block of forest of twenty acres which has yielded for the past twenty years about twenty-five cords of wood annually. (The same area of woodland, well cared for, and pruned, would yield much more.) The undergrowth has never been disturbed by cattle, and the young trees consequently have always grown up ready to replace the others. There are plenty of young trees there now—tall straight slender shafts sixty feet in height, and but six or seven inches through; while so many trees of good size are ready for the axe, that it is evident that the forest will continue, at that rate of cutting, to reproduce itself for ever. Throughout all the older settled portions of Ontario, and throughout the newer sections as fast as they are to an equal extent cleared, such fuel will soon be worth \$3.50 per cord besides the cost of cutting. If we also remember the fact that for at least one-half of this very cord-wood there is now springing up a demand as sawed timber, which of course commands a much higher price, it will be seen that such a fifteen acre block, cattle being carefully excluded, and some care taken in cutting not to damage the surrounding trees, will be shortly the most valuable part of the farm; it would yield a probable rental for cordwood and square timber of about \$10 per acre; and it should always be remembered that, while it is kept in good bush, the owner can always change the timber to a more valuable description. He can plant within its borders, among its own natural undergrowth, thousands of nuts and seeds of the white oak, the hickory, the walnut or any other kind he may fancy, and may, by such means, double the value of his timber reserve. Though the farmer may never himself live to see these trees of age to cut, yet he himself may obtain full value for his labour. Walnuts planted to-day in the forest ground should give, in twenty years, walnut timber fit for numerous purposes—in thirty, large trees fit for many a portion of side-board, table or inlaid cabinet. Other trees will be almost equally valuable. Say the farmer wishes, ten years from to-day, to sell his farm. The purchaser, let us suppose, is a young man. He may well say, "I am likely to live twenty years; I shall then be only in the prime of life, and by that time there will be timber here from which I can cull for all succeeding years as much as will readily sell for a large sum annually, or if I should choose to cut the whole there will be some thousands of dollars' worth ready for the axe." Of course, then, he will give far more to the farmer who planted the trees than if the work had never been performed. The farmer has not then lost his labour, although he may never see the trees mature.

It would be, undoubtedly, well that farmers would determine each to maintain a reserve of forest of this nature on their land. When we consider that the time is very shortly coming—nay, in many sections, is now—when they can gain yearly a considerable sum by the sale of full grown trees, for firewood and sawed timber—considering that in a short time fuel will be scarce in most parts of Ontario, it would seem that the wood-lot should not be diminished on any consideration. This feeling is not, however, as general as it should be. Lately, I was travelling about thirty miles in one of our frontier counties, and came to only one good hard-wood bush on the route. It was about fifteen acres, and the owner being offered \$1,500 for leave to cut the timber for cordwood, was about to let

it go. People said that it was a pity he ever cleared the farm, for the uncleared piece was proving more profitable than all the rest. On being asked whether it would not be better to keep it standing, as it seemed in thorough reproductive condition—cattle having been always excluded—and yearly sell wood from it, the answer was “Nobody seems to do that about here.” Nobody did seem to, in fact, for the country was getting as bare as the Steppes of Russia, and the winter wind, passing over the far extended snowy surface, seemed to blow through one.

In all efforts, however, made to keep a piece of the original forest standing and in good condition, the prime necessity is the exclusion of cattle. To give the trees health and vigour, the ground must be the original forest soil, dotted with infant trees just rising from the ground, with taller undergrowth of long and upright saplings, emulous of being the future tree, with large trees fit to cut, and with younger ones nearly ready to replace them. In such a bush-plot the grass cannot get in and overspread the ground, for it is shaded by the undergrowth. Next, as previously stated, a most important consideration, the young second growth trees, rising up around the edge of the bush, will never blow down, and will, as they increase in height, keep the wind from all the rest. The whole of the forest trees, too, young and old, grow much more vigorously when the undergrowth and young and springing covering of plants around and among their roots, which is their natural mulching, is not destroyed. A block of forest so treated, and with a little assistance in case of unforeseen accidents, will reproduce itself for ever.

Throughout settled Ontario any plan of forest preservation needs the farmer's co-operation, for he holds the forest remainder. In all directions that remainder decreases. The axe, which once thinned, now extirpates. It is full time that, on ten or twenty acres of every farm, the chopper should stay his hand. But he must do more—he must exclude his beasts; where hoof and horn range down go undergrowth and sapling—in a moment, before their placidly devouring jaws, vanishes the umbrageous wealth of the flexile branch and delicately-pencilled leaf—gone is the promise of hardy timber yet to come. The little youngling elm, his green and double leaf fresh springing from the soil—the infant cotyledon of the future oak—the maple bud and the sprouting ash are no more; and from tree to tree is nothing but trampled leaves. The forest ground dries and shrinks; far above, the giant masses of the upper foliage alone oppose the rushing wind; the undergrowth below—the natural barrier—is gone; the air sweeps through; some stormy morning the outward ranks are prone—the beech and the great oaks lie across; with the next tempest more will follow. Our enemies are those of our own stables; and our farmers may say, “With the jaw-bone of an ox, heaps upon heaps, have I slain a thousand trees.”

On every farm some forest is needed to break the winter winds. It is needed to keep level the drifting snow. It is needed for pleasure; he who has near his house a forest walk of his own, where he may for a space enjoy the health-giving atmosphere, and

“Under the shade of melancholy boughs
Lose and neglect the creeping hours of time,”

has opportunities many would give much for. It is needed to aid in procuring rain in due season. It is needed as a store-house of timber—soon likely to be full scarce throughout the land.

We found here the wood—the water—the fertile soil. It is certain that the deforesting of a country in process of time does more than withdraw the one ; it greatly impairs the others, so much that the land may not then support one-tenth of those it now could maintain. Proprietors should remember that no one can possess a title to destroy the usefulness of the soil, lest, “the land cry out against him, and the furrows thereof likewise complain.” The vast concourse of humanity continually emerges from the unknown past ; it travels toilsomely by ; it passes into the clouds of the future. Be sure that there we shall meet with stern questioners ; nor will those pass unchallenged who have, to serve their temporary greed, rendered painful, sterile and barren, the path of generations yet to follow.

PRESERVATION OF EXISTING PORTIONS OF FOREST.

Of all branches of Canadian forestry, one of the most important is that which treats of the advisability of preserving some portion of those fragments of the original forest yet standing on our farms. When we consider in how many parts, both of Europe and America, the land owners, finding by sad experience the evils of a deforested country—finding that the farm yields not so rich—not so easily obtained—a return to the husbandman—taught also some sharp lessons by scarcity of timber formerly easily to be had—are busy in replanting, not by dozens or by hundreds, but by thousands and millions of trees, and observing, as we are compelled to observe, that throughout most of Ontario the same process will soon be necessary, it is natural to look around us, and consider whether we are not in a position to do something better.

All through settled Ontario, there are yet many valuable portions of woodland, here and there. One farmer will have ten, another twenty, a third forty, acres of forest. Where cattle have been excluded from these, it will be found that there is plenty of undergrowth, young saplings, half-grown trees, trees nearly matured—plenty of materials, in fact, for the continuous replacement of the forest. In such a reservation, too, it will be found that the original soil of the forest, a thick coating of rotten leaves overlying a mass of vegetable mould, is still there. On the outsides, too, it will be found, if matters have been rightly managed, that the undergrowth, as fast as it arose to tree size, has preserved its branches nearly down to the ground. There will be found here the three things necessary to perpetuate a forest, namely, the drying winds cannot blow through ; the bark of the older trees is protected from the sun ; the forest ground is kept moist, rich, open for the reception of tree seeds, and in a situation to nourish and cover the roots. Where we find matters so, all that can be said is, continue the treatment, cut out carefully, year by year, the larger trees as you need them, and the diseased as you observe them, and nature will always keep you a forest. Here, too, if you like to assist nature with better seeds than the wind might bring, you can sow or can plant whatever you like, and the forcing process of the forest, each young tree continually striving to attain to the forest roof where alone its branches can receive light and air and put forth leaves—will give you all and straight timber more quickly than you can obtain it by any other method. White oaks, ash, walnut, hickory, chestnut—in fact, any trees desired can be easily grown in such a wood.

But one of these small forests, to which cattle are allowed free entrance, will be found in a very different state. Unless they are few in number compared with the size of the forest, or that they have access to such rich pasturage as to deprive them of the inclination to destroy the young trees, they will certainly kill the undergrowth, unless it be evergreen, which is seldom the case. (Here it may be remarked that a hardwood forest might be maintained in good condition where cattle must be allowed, by encouraging or even planting an evergreen undergrowth—pine, hemlock and cedar; these would protect the soil and the larger trees, which would then grow to maturity, and your hardwood forest would in time become an evergreen glade.) But where the undergrowth is deciduous, and cattle destroy it, no young trees can rise, the forest becomes thin, the sun beats on the bark of the larger trees, (a thing the forest tree has not the bark to bear; the field tree bark is dense; that of the shaded forest tree tender); the young trees gone, wind and sun dry the ground, it becomes carpeted with grass, the great trees begin to die at the top, the decay of the older forest is only a question of time and there will be no young one to replace it.

In many of these reservations, there is yet much good timber, and if care were taken there might be a perpetual succession of such—even now, as remarked, there is much good red and white beech, black and white ash, elm, cherry, oak, maple, and many another tree. How valuable these are likely soon to become, the statements in other pages from practical men, engaged in the use of these woods, inform us. What I should like therefore to suggest is, that where any reasonable amount of forest, say ten or twenty acres, exists on a farm, it is great waste to allow cattle its complete range. Let them have a few acres for shade, but for the rest, if left to grow timber—above all, if assisted to grow timber, it may, in a few years yield without labour, a return more valuable than any other portion of the farm. To illustrate this, I may remark that in another page will be found a statement by Mr. Culbertson, near Chicago, whose ten acres of woodland, planted by himself, he now considers more valuable than the other 260 acres of his farm.

Most of our existing patches of forest could well be preserved. A little attention to fencing, planting or sowing would shortly convert many a decayed and apparently dying portion of forest into thriving woodland. Planting forests, where necessary, is an excellent thing, but time is needed to obtain the result. In preserving an existing forest, on the contrary, much may be done in a very short time. The three rules are, encourage the undergrowth, exclude the sun, exclude the wind.

We will now give a few pages to statements from different parts of Ontario, describing the results which have occurred from the general clearing of the forests throughout the Province.

Mr. M. J. Fisher, writing from Maxville, Glengarry, Ont., says: "Though our lands here are but partially cleared to what they will be at no very distant time, the stretches of bleak clearing without breakage seem too large, to the great discomfort of the grazing cattle, who make for the sheltered parts in the cold winds of spring and fall, as well as during the scorching summer suns. Another fact worth noting is that the only parties known to raise fall wheat with success—or with whom success is the standing rule—are such as have their fields surrounded, wholly or partly, by wooded lands, not their own, still uncleared leaving the snow of nature to do its sheltering office.

Rev. W. H. Moss, Milverton, Perth, writes:—"One thing seems clear—the forests are fast disappearing. Many farms to the south have been stripped of almost every tree

—the result of fires. The lumberman is also very busy in these parts, sawing up pine, cherry, ash, hemlock, etc., so that in a very few years all lumbering must cease here for lack of material. Clearing has also been carried too far in many cases. The result is that, although this is comparatively a new country, wood is getting scarce, and in winter we have dreadful drifts in most of our roads."

Mr. A. Drummond, Howick, Huron, writes:—"As to the change in rainfall (excepting the present) the seasons have been much drier of late, than they were for a number of years after we had settled in the woods here, some 25 or 26 years ago. The drought seems to be more penetrating now than the woods are away. Creeks in this part get very low, and those fed from swamps often dry up altogether."

Mr. R. W. McLaren, Plympton, Lambton, writes:—"The woods in this neighbourhood are very thin as a general thing. About twelve years ago the fire went through them and destroyed a great deal of timber. Creeks stop running very soon after drought sets in. I do not think the clearing of the forests has actually lessened the rainfall, but it goes more to extremes now."

Mr. Philip Kelly, New Durham, Oxford, writes:—"The first settlers came into this neighbourhood about fifty years ago. Since that time the woods have been cut down very rapidly, till now the neighbours, as a rule, have no more wood than they need for their own use, and a few have none at all. I think about 85 per cent. of the land in this neighbourhood is cleared. Springs and creeks here are drying up; that, however, is to be traced to two causes; the first being the cutting down of the forests, the other, underground draining."

Mr. G. Fortune, Turnberry, Huron, writes:—"I think, including swamps, there must still be one-third of the land in Turnberry uncleared; and I do not know that we have felt any inconvenience from the amount of clearance as yet; but there is no doubt that we will soon feel the want of firewood, as also of lumber for building purposes. I do not know of any difference here in the amount of rainfall, but the small creeks dry up a great deal sooner in the spring, than they did twenty-five years ago. Our rivers, too, get far lower in summer; where there was at that time, in some places, plenty of water to drive a mill, they have now either to put in steam or allow their mills to lie idle during the summer."

Mr. James McCool, Londesborough, Huron, writes:—"In this part the forest is becoming rapidly cleared; in a few years some farmers will have neither firewood nor building timber. In regard to creeks, I may say they have mostly all dried away since the land has been cleared, even those which had been considered to be never failing."

Mr. James Johnstone, Carrick, Bruce, writes:—"As to change in the rainfall, I am of opinion that there is not much change here yet, but there is quite a change in manner of rainfall getting into the creeks and rivers. Formerly, when this country was covered with forests, the rain very gradually soaked its way into the ground and thus slowly raised the springs, creeks and rivers. Now, after rain, the creeks receive it much sooner, as a great deal of the water does not penetrate the soil at all, but flows over the surface and gets at once to the creeks, and raises them sometimes very suddenly. I think that the normal state of our creeks on this account is changed. And for the same reason we have more floods and also more times of low water."

Mr. John Bishop, Palmyra, Elgin, says:—"The creeks dry up much sooner than they used to, and some that held water the year round, are now dry a good part of the summer."

Mr. Edward Haltes, New Germany, Waterloo, says:—"With regard to rainfall, there is a change since the bush is going down, and the old swamps cleared up and drained for pasture land. Taking ten years, I noticed that six out of the ten, it is rather too dry for pasture or spring crops on light land."

Mr. William Elliot, Parkhill, Middlesex, writes:—"This neighbourhood is almost entirely cleared of forest, farmers reserving only what is necessary for firewood. The result is visible in the drying up of small streams in summer, and the injury done to crops by cold frosty winds. I think the absence of shelter for growing crops the most injurious consequence of the removal of the original forest."

Mr. A. D. Ferrier, Fergus, Wellington, writes:—"This neighbourhood is getting to

be very bare of timber, and we feel the wind very much. Firewood is very dear and scarce."

Mr. Thomas Baird, Bright, Brant, writes:—"It is the prevailing opinion among men of science that the clearing of the forests has the effect of restraining the rainfall. I was reading lately that through the reckless destruction of her forests, some of the Provinces of Russia had almost become a barren waste. We must expect the same results to follow in Canada. There is no doubt that the clearing up of the country has had a powerful effect on drying up creeks and rivers; the ditching and under-draining of low lands allows the water to run quickly off, and hence those sudden floods from which we have suffered so much this season."

Mr. Robert Watson, Windham, Norfolk, writes:—"With regard to the extent of clearing our forests, we have no forest to clear. Most of our farmers have little preserves of timber, varying from ten to fifty acres; from this all the timber fit for sawing has been sold, and some small farmers have none left for their own use. With regard to the drying up of rivers, creeks and springs, I know something about that. I have lived fifty years in this part of Ontario. When I first came there was a great part of the forest standing. Some creeks that would drive machinery the year round then, are now dry, some of them not affording water sufficient for the stock on a small farm. Others, where the mills are a necessity, have had to put in steam to afford them power to run in the summer season. Then we never housed our live stock before the 25th of December. Now we have to feed them with winter provender, sometimes in August, often in September."

Mr. Thomas Shipley, Falkirk, Middlesex, writes:—"Old settlers here state that the climate is changed, being more irregular in falls of snow and rain, with much more wind, cold snaps and uneven weather. Our springs and creeks are affected. This is a hardwood section of very heavy growth; seventy-five per cent. is now cleared and the work of clearing goes on, resulting in more destruction, high winds and all other changes connected with the destruction of the forests."

Mr. William Ross, Painswick, Simcoe, says:—"I very willingly testify to the creeks and springs drying up as soon as the forest is cleared away. There have been many discussions on the planting of forest trees among us farmers; but it seems hard to make a beginning."

Mr. F. Malcolm, Innerkip, Oxford, says:—"In this section very little timber remains except what is intended for fuel, and this is disappearing much faster than was expected fifteen or twenty years ago. Severe winters and high winds—disagreeably felt on account of the great reduction of forest trees—are having a disastrous effect on what remains. You will understand that where the wood is worth \$50 per acre, and the land as much more when the wood is off, there is a strong temptation to denude; and this in the face of the fact that all are aware of the benefits resulting from forests as a windbreak. For the want of this our country has been ruined for apple-growing, that is, of such kind as we generally have; our roads are drifted, buildings unroofed, fences blown down and a degree of cold experienced that the settler of thirty years ago knew nothing of."

Mr. John H. Houston, Petrolia, Lambton, says:—"I knew this country when it was a dense forest, so that I can tell you how much the forest has to do with us. There is no doubt that storms now sweep over with more violence; wherever our fruit trees are well sheltered they bear better. As regards the rainfall, the rains are more heavy, but not so regular. As to the creeks, the more the forests are cleared the sooner they dry. The water now gets a better chance to get quickly to the creeks."

Mr. Thomas A. Good, Brantford, Brant, says:—"Wood is getting very scarce in this vicinity, and in a few years there will be hardly any left. There is no doubt that springs are drying up. We get our rains now in too heavy dashes, and nearly every year lately we have had a period of severe drought caused, no doubt, by the timber being nearly all cut away. Our county has the smallest per centage of wood, I think, than any other county in the Province, not even excepting the County of York. Springs that I knew when a boy are gone, and others come to the surface further down the hills. If we should get a few dry summers there would be still more difference observed."

Mr. Thomas Smith, Rosemont, Simcoe, says:—"The neighbourhood is fast becoming

stripped of its forest on account of a settler being on every hundred acres, and when each farmer was clearing up his land he thought from five to ten acres was sufficient woodland to leave. The consequence was, the wind got such a sweep that it blew down a great deal of the heavy timber; and as the bush got thin the sun got striking at the roots of the trees, then such timber as hemlock and beech commenced to die, and thus the thinning of the woods went on."

Mr. John A. Campbell, Simcoe, says:—"The evil effects of too much clearance are as yet principally confined to the increased risk to the fall wheat. We grow fruit and vegetables also to some extent, and for the past two years have had some sharp experience of the evil effects of cold winds. It is also possible that the growth of our farm crops may be retarded thereby, though not to the same extent."

Mr. A. Milgan, Blenheim, Oxford, says:—"This part is being cleared pretty thoroughly. One of our councillors remarked at a meeting the other night that this township (Blenheim) had not any timber left to build her bridges, people being of the opinion that they can do better by cropping and then buying their fuel."

Mr. John King, Middlemarch, Elgin, says:—"Seventy-five per cent. or more in this locality is cleared, and in what is left openings are made which will let the wind sweep through and destroy it. Farmers are complaining that their wheat in winter is exposed to high winds, blowing the snow off and allowing the plant to lie exposed to the frost, killing it right out."

Mr. D. Kennedy, Peterboro', says:—"Timber is becoming very scarce indeed in this neighbourhood. Many farmers of from 100 to 300 acres are now buying firewood, and some are using coal. Fully half the farmers of this part will have to buy firewood before ten years. The prevailing opinion is that clearing the forest diminishes the rainfall."

Mr. Richard Shortill, Ballinafad, Wellington, says:—"The clearing up of the hardwood land and the old swamps has so much dried up the creeks and streams that several large streams, which eight or ten years ago drove large mills and factories, have gone dry, and only run when the fall and spring rains swell them up."

Mr. M. Martin, Tilbury East, Kent, says:—"It does appear that the annual rainfall is decreasing in quantity, a very dry season taking place every other year. Cannot say whether it is caused by the clearing of the forests. I may say further, that farmers are beginning to learn the importance of having a belt of wood or shade trees to shelter the winter wheat, invariably a good crop being obtained where it has been sheltered by a wood or a belt of trees."

Mr. William Patterson, Almonte, Lanark, says:—"As to the rains, since so much of the forest has been cleared, there is a marked falling off with the exception of this year. During the last ten or twenty years there has been cause for serious alarm; droughts of three or four months with not a single shower have been of common occurrence."

Mr. John Malone, Niagara Falls, says:—"Thirty-five years ago, with plenty of woods all round, good crops of fall wheat were raised here with very poor cultivation. Now the most improved cultivation fails. The snow blowing off the fields leaves them exposed to the frost. Where a field is protected by woods south-west or north-west, a crop of fall wheat rarely fails."

Mr. Robert Flynn, Olden, Frontenac, says:—"Where the woods have been cleared or burnt off, the springs in the granite ranges (where pineries largely were) and even in the hardwood ranges, are almost completely dried up; with the exception of some old boiling springs which seemed to be supplied by some heavy waters at a distance. The rivers, creek and lakes are very much reduced in their supply of water—some small lakes wholly dry. The fall of rain and of snow is greatly reduced."

Mr. W. J. Westington, Hamilton, Northumberland, says:—"I have frequently observed (with the exception of the present year) that thunder storms follow the belts of timber lands and lakes, which plainly shows that the evaporation from the trees attracts rainfalls. Since the land has been denuded of the timber, rivulets and creeks have become perfectly dry, large rivers have been greatly diminished and lands which were here bog holes are now quite arable. Wells, formerly considered never failing, have gone completely dry, and large sections of country have to depend solely on cistern water."

Mr. H. J. Barber, Boston, Norfolk, says:—"In this neighbourhood timber has become

scarce, where at an early day it existed in abundance of all kinds and of the best quality. A large amount of first quality pine was cut down and burnt with the other timber; but since there has been a market for pine lumber, it has been rapidly cut and sent off, until scarcely a pine remains to be seen, except bushes, which, if protected, would soon replace the old for coarse lumber. Hard timber has also been slaughtered until the farmers begin to see their folly and begin to talk about it."

Mr. R. Craig, Belmont, Middlesex, says:—"When there was plenty of forest there was always plenty of water; it is very dry in this section at present."

Mr. Geo. Binnie, Bunessan, Grey, says:—"I do not think that the rainfall is any less than before, but I think it falls at more irregular intervals, and in greater quantities at once; that the weather is more liable to extremes both in drought and rainfall than it was some fifteen or twenty years ago. There is no doubt that the destruction of the forests has had an effect on the streams of this country, the tendency being to decrease the volume drained off by them in several ways. The ground absorbs more of the rainfall, it evaporates more quickly, and what is left drains off sooner than when the country was covered with forests."

Mr. Henry Doupe, Kirkton, Perth, says:—"I must say there has been a drying up of creeks since the forest has been cleared away—that is the water goes away earlier in the spring, and is less in the creeks in summer than formerly. When rain falls it gets away more quickly, which may be accounted for by open or underdrains leading to creeks and small streams, and also from the effects of wind and sun on cleared land. As to the quantity of rain, I would say that I think it very little less than formerly. During the past summer more rain fell here than in any season for the last thirty or forty years. When rain falls with thunder, I think for the time it lasts that it falls more heavily than formerly. The woods are getting less every year—there are a few farms that have no woods standing—mostly all have from five to twelve acres of bush. I am speaking of a radius of ten miles all round."

Mr. Benj. F. Browne, Gamebridge, Ontario, says:—"The disappearance of the forests is certainly affecting the rivers, streams and springs in this locality. Streams and springs that had been running since the memory of man were quite dry in 1881 and 1882, and water in many places was very scarce."

Mr. Robert Purves, Kinloss, Bruce, says:—"I am of the belief that with proper wind-breaks we could uniformly raise better crops. Some say that the reason we do not raise as much per acre now as when the country was new is that our lands are becoming poor; but such is not the case in many instances, as the new land we clear now will not yield the same per acre as when the country had more shelter."

Mr. James Ross, Barrie, Simcoe, says:—"Our creeks dry up very fast after the forest is cleared away; also our rainfall is very much less—not nearly so many summer showers. My opinion is that tree planting should be encouraged as much as possible for the general benefit of our country."

Mr. G. D. Platt, Picton, P.E.I., says:—"I believe that belts of forest trees across our farming lands would prove of value in mitigating the severity of droughts, as well as in retaining the natural winter covering of snow as a protection to fall crops. I have frequently observed instances proving the great value of groves and clumps of trees in the latter respect."

Mr. S. Kennedy, Gainsboro', Kent, says:—"The rainfall is considerably less now than it was when the country was first cleared."

Mr. J. M. Freeman, Pleasant River, Queen's, N. S., writes:—"Our dry seasons seem to be longer than formerly."

Mr. George Allison, Watertown, Wentworth, says:—"I am satisfied that the sudden climatic changes are largely due to destruction of our forests. There is getting to be a scarcity of timber now, and there will soon be a far greater scarcity."

Mr. Robert McAdam, Sarnia, says:—"Regarding the influence of forest growth in water supply, I may give you a fact within my own knowledge. On my father's farm was a small 'beaver meadow' of eight acres, surrounded by, and partially covered with a growth of tamarac, spruce and small pine. In one corner was a spring strong enough to supply a small stream, and for making a never-failing water supply for cattle. Some years

ago a forest fire ran over the land and killed all the timber round the meadow, leaving it open to the sun. It dried to the bottom, and next season it was found that the spring had ceased to flow, and the creek had in consequence disappeared. A fence was placed round the meadow, not following its irregular margin, but in straight lines with results of leaving a space between the fence and the edge of the marsh, of from ten to fifty yards in width, and this marginal space at once threw up a strong growth of young timber which in a very few years made a dense thicket. No sooner had the thicket began to shade the ground than the spring again began to flow, and has since continued to do so; and, as far as I have been informed, has not failed even in exceptionally dry seasons."

Mr. Robert Flynn, Olden township, Frontenac Road, says:—"As to what extent the country is cleared. In real *bona fide* clearance I do not think there is one-eighth, but fire and lumbering have not left us one-fourth."

Mr. Moses Leairs, Severn Bridge, Ontario, writes:—"In a very few years many in this new settlement will have neither pine nor hardwood of any account."

Mr. Daniel Marshall, Keppel, Grey, writes:—"Ten years ago this neighbourhood was nearly all forest, but the forest is being cut down everywhere, rock elm is all gone for square timber. Now the axeman is in the swamps, cutting telegraph poles, railroad ties, fence-posts, and saw-logs, our saw-mill men are calling for all kinds of hardwood, and saw-logs, so that in ten years more there will only be culls, except some small pines that are protected. Our firewood will not be easily obtained in ten years from now."

Mr. J. Rudd, Clinton, Huron, says:—"As to what extent this neighbourhood is becoming cleared: Some farmers have not one acre of woodland while others may have from five to ten acres; there may be an exceptional case of fifteen or twenty acres."

Mr. John Darby, Crown Hill, Simcoe, says:—"The hardwood forest is being rapidly cleared away, so that many farmers find themselves already without firewood for their own use. The principal part of the forest left is composed of low-lying or swampy land. Timber for building purposes is scarce, and hemlock lumber is taking the place of pine where practicable."

Mr. George Buskin, Artemesia, Grey, says:—"The Saugeen River and Little Falls River both start in this township. Since the forests are partially cleared, both of these are failing in the summer months. I believe, in time their mills will have to put in steam."

Mr. J. A. Ramsden, Sherkston, Welland, says:—"A considerable number of farms are entirely cleared of forests, and perhaps ten acres of the hundred throughout the township would be about the average of the woodland still uncleared; but it is being cleared all the time, and dying, and at no distant period the original forests will all have disappeared from this section of the country."

Mr. A. M. Wigle, Ruthven, Kent, says:—"I am sorry to say that the original forest is in many localities all gone, and there is no spontaneous growth, nor any effort to reproduce; but a continual cutting at the little clumps of bush left by the first settlers. I would and do say to some, "woodman, spare that tree;" but although young men do see the havoc of hard winters on their wheat, in the unsheltered fields, yet they hope it will not be so next year, and they go on cutting their bush."

Thomas Beckton, Glencoe, Middlesex, says:—"This part is getting cleared. The farms are small, so that home consumption is using up the wood. The storms in summer blow many trees down."

Mr. B. B. Smart, Sarnia, Lambton, says:—"One thing is certain, that timber is every year becoming scarcer—both fencing and building timber is very scarce now. The half of the farmers on this line now could not find timber enough on their land to build a barn, and where the supply is to come from ten years hence is hard to tell."

Mr. John Gibson, Milliken, York, says:—"I am sorry to say there are but few in number that have bush worth fencing in, and many have none. There has been a fearful waste, and no doubt the want of timber is now greatly felt."

Mr. Jno. McMillan, Constance, Huron, says:—"In this neighbourhood the woods are disappearing very fast. On account of cattle running in all the pieces of bush left, there is no young timber or undergrowth. Most of our streams dry up in ordinary dry seasons, and many wells give out that have been in use for twenty years."

The reader will observe that a great number of experienced men give it as their opinion that the over-clearing of the forests in Ontario is drying up the surface of the land. The numerous underground channels, fed by the forests, which formerly flowed near that surface, giving life to the earth, and enabling, in dry seasons, the roots to obtain that moisture below which the parching skies deny above, have receded to a much greater depth. Formerly, in digging for water, we frequently struck a spring within six feet—now we are more likely to excavate forty before obtaining it.

We have but results by which to judge. The chief operations of nature are hidden from our view. We see the young tree grow—the buds come forth—the leaves in green luxuriance cover the branches—the tender blossoms open—the fruit appear and swell to full and rich maturity. But the actual process of accretion, particle by particle—how sun, and air, and earth, and water, wrought unanimously, till in turn appeared a clothing of leaves—a brilliance of flowers—a weight of fruit—where, months ago, leaf, flower or fruit was none—is among the secrets of creation yet but partially fathomed. But we know that each gave their aid—that the earth opened its storehouses—the air gave of its treasures—the sun and the rain warmed, tempered, adjusted, and carried on its way the nourishment the others supplied. And we know that when successive suns have warmed the earth and air, and successive showers again have moistened all, till branch and tree-trunk drip and flow, and the dry ditch is a clear rippling rivulet again, that then the cornfield puts forth and increases its wealth of pendant leaves, that the fast growing wheat reflects the light in deeper waves of fresher green, the broad embowering grove seems to rise in newer beauty, and cast forth stores of undiminishing fragrance upon the air. It is the result of the regular succession of heat and moisture—it is the great process of nature by which the earth is enabled to bring forth its increase. It is with this we interfere when we deforest the land.

This succession of moisture and fertilizing alternation of heat the field frequently owes in great part to the adjacent forest. If the atmosphere be too dry and vegetation suffer, the great reservoir of moisture round the forest roots is busily supplying the exhausted water channels below, and simultaneously sending vast columns of moisture through its leaves into the atmosphere above—moisture which must shortly fall in rain again. But when the atmosphere is surcharged with moisture, when above our heads the watery stores are passing from the equator to the pole, and rain is falling heavily every day, it does not leave the forest as the field; it is retained in the forest bed in millions of tons, for the benefit of both field and forest in a drier time.

CORRESPONDENCE CONCERNING SECOND GROWTH.

I will now give extracts from correspondence from many parts of the Province, written by persons who, in all cases, have observed for themselves the progress of second growth, and the reproduction of the forest; and who are, it will be noticed, unanimous in the opinion that cattle must be excluded from such portions of woodland as it is desired shall long continue in existence.

Mr. Henry Westney, Highland Creek, York, says :—"As far as I have observed, the result of cattle being kept out of the woodland has been a dense growth of young trees of remarkably straight and rapid growth ; while, on the other hand, in those pieces of bush to which they are allowed free access, the undergrowth is very scant, small bushy trees trimmed like a hedge, or broken down and destroyed by them."

Mr. Thos. Fraser, Amberley, Huron, says :—"If trees are under four or five inches through, cattle are a great injury to them, as rubbing on the tender bark, and bruising it with their horns, will cause the bark to rise, and it might as well be off."

Mr. J. A. Ramsden, Sherkston, Welland, says :—"I have noticed that where cattle and horses are pastured in the bush, they keep down all the second growth and the trees are rapidly dying off ; and I have also noticed that where the woodland is not pastured the trees look much more healthy, and there is almost invariably a thick undergrowth."

Mr. Thos. Phillips, Bond Head, Simcoe, says :—"Were it not for the cattle eating the small shrubs, there is no doubt, where not tilled, there would soon be a good stand of timber of the hardwood variety. I have seen a good growth of young plants start in the spring, of the maple, oak, elm and basswood ; but the cattle soon eat them off. In the timber lands where cattle are not allowed access, there is generally a good growth of timber in this locality, of maple and beech. It would take about five years to attain sufficient height to be out of the reach of damage by cattle, as they are very fond of young timber."

Mr. D. Shooley, Ridgeway, Welland, gives another idea. He says :—"The cattle will not browse or bother the young trees after the first of June. Where the bush is getting thin and reproduction is wanted, I would advise keeping cattle out for three or four years, also early in the spring a few years longer ; then, if thinned out would be a very cheap way to replenish the woodlands."

Mr. John Gibson, Milliken, York, says :—"I have never seen, where cattle had a free run in the bush, that any small trees ever came to anything—they are invariably scrubby and stunted."

Mr. Andrew Childs, Rutherford, Bothwell, says :—"Doubtless it would be of great importance to have cattle kept out of woodlands—woods that are intended to remain as such to supply firewood and timber for fencing, or for mechanical purposes. In fact small trees have scarcely any chance to grow unless protected from cattle."

Mr. George Sanderson, Colborne, Northumberland, says :—"I have kept cattle out of a small wood lot, for a few years, and now it is so thick with small young trees that one can hardly get through. There are lots of maples, ironwoods, beeches and basswoods, from six to twelve feet high—just right to set out along the fence. Some are from one to three inches in diameter. I think the large trees are growing better and look more thrifty than they did before I gave up pasturing. I let the cattle run in the wood now after harvest and they do not seem to do any damage. I am sure it will pay to keep the cattle out for a few years at most."

Mr. N. A. Malloy, Laskay, York, says :—"The effect of keeping cattle out of woodlands is quite apparent, the young wood coming up quite readily. But when cattle are allowed the run of the woods at pleasure, scarcely a plant remains unless it happens to be protected by logs or brush."

Mr. R. Postans, Oakville, Halton, says :—"I know that cattle will sometimes destroy a great number of young trees ; in a dry time when pasture was almost burnt up by drought, I have seen an ox bend down a young sapling over two inches in diameter and twenty feet high, keeping his neck over it till he had broken it down, or holding it down till he had browsed the top."

Mr. Thos. McLeod, Dalston, Simcoe, says :—"If you wish to preserve a young plantation, by all means keep cattle out—sheep are even worse than cattle."

Mr. David Spence, Whittington, Wellington, says :—"A friend of mine fenced off five acres of bush for the purpose of allowing the second growth every chance to grow ; and I assure you it is beautiful to look at—in three years you could not see a man one rod off it was so high and so thick. There would be no use in keeping cattle out five, six, or even seven years and then letting them in. I have seen cattle in a bush throw their neck over a sapling like a handspike, and would bear it down until they had eaten all the foliage off—then it is sure to die."

Mr. George Leverage, Fullarton, Perth, says :—"I have noticed that cattle will in a very short time destroy all the under-brush in a piece of vigorous woodland."

Mr. Thomas Smith, Rosemont, Simcoe (a keen observer of nature), says :—"I think it would be well for farmers to try the experiment of keeping cattle out of a portion or all of their woods. As the bush gets thin the sun strikes at the roots of the trees, then such timber as hemlock and beech commence to die, and thus the thinning of the woods goes on. I notice that where there is a thick growth of underwood the larger trees keep greener and more thrifty, in fact the whole woods resemble more closely the original forest."

Mr. Thomas Shipley, Falkirk, Middlesex, says :—"When timber land is cut or slashed and lies in a rough state, the young trees come up rapidly, but before they attain any strength the fallen timber and brush which protected them is either burned, or is so decayed that cattle get in and nearly all are broken down. Some few grow up, but the growth is thin, and they grow bushy, branching out about ten feet from the ground, and become all top and not much trunk. I have about twenty acres like this—the trees are about twenty years of age, thirty feet high and one foot in diameter (elm, oak, beech, ash, basswood); but cattle and grass prevented a thick growth, and they are not, and never will be, anything like the forest primeval. Apart from the planting of forest trees, which can be done, I must say that in my opinion it would be an easy matter to reproduce the forest, simply by protecting it from all manner of invasion."

Mr. John King, Middlemarch, Elgin, says :—"I believe that allowing cattle to run at large in forests is almost certain destruction to anything like a healthy growth to young trees. I know of some few, and but few, who keep the cattle out of the forests, and their woods are so thick with underbrush that it is difficult to walk through them; and as to the majority of forests where cattle are allowed to run, you can ride on horse-back through them anywhere."

The following shows how easily the seed will take. Mr. Robert Currie, Wingham, Huron, writes :—"In this part of the country the cattle will keep down the young sprouts and saplings in winter and the tender leaf in summer. I have had a field near to the bush ploughed early in the fall of the year before the maple seed fell, and the wind blew the seed over the field so even that in eight acres there was not one square foot in any part of the field without a plant, and the nearer the bush the thicker they grew. The field was for roots, and was not ploughed until the 10th of June, when the plants were from four to eight inches high all over the field. People who are planting here use maple principally. The sapling from seed of maple or cherry will not on an average exceed one foot in the year; but if from roots of old trees of either variety they will often grow more than two feet in a good season. If anyone wants to have a piece of bush here, either planted or the small underwood reserved, they must keep cattle out of it; it would take six or seven years to be out of the reach of even small cattle of one or two years old."

Mr. A. D. Ferrier, Fergus, Wellington, says :—"Cattle will destroy every kind of tree they can reach, and seem to delight in the work of destruction."

Mr. Thomas Baird, Bright, Brant, writes :—"Whenever the forest is thinned out the Indian and other grasses get in, and when this is the case the underwood ceases to grow."

Mr. Philip Kelly, New Durham, Oxford, says :—"Mine is the only hardwood bush that I know of in this neighbourhood where cattle are not allowed to run, and it is also the only one in which there are any young trees."

Mr. John Bishop, Palmyra, Elgin, writes :—"Fence off a piece of woods and it soon starts up as thick as it can grow; but let sheep and cattle run through woods and all undergrowth is cropped off, and grass takes its place, crowding out even the trees that are left, except a few of the hardier kinds."

ONTARIO OBSERVATION AND CORRESPONDENCE.

The following pages give many instances obtained both by actual observation and correspondence concerning forestry in Ontario, and will give the reader an idea of what slight progress we have made in this important matter. Since the late agitation on this

question, induced by governmental and other efforts, I am glad to say a number of attempts have been made in this direction. Descriptions of these, however, are better deferred to another year, when their success can be better noted. In the meantime, the reader will find, here and there, valuable evidence concerning the different branches of forestry.

The Lombardy poplar, in situations such as between roads and grass land, where its occasional propensity to sucker will not harm, is known as an excellent wind-break. Yet it has been objected, that it breaks off in strong gales. I do not find this the case, but some instances to the contrary. For one, at Mr. C. R. Sing's farm, St. Vincent, there is a row of magnificent poplars in front of the residence, two feet through at the ground, sixty—nearly seventy—feet in height, a broad mass of light green foliage from base to summit,—a landmark far across the water, planted but twenty-four years since. Cords and cords of wood could now be cut from their massive trunks, and will be some day, poor as are its burning qualities, if we plant not our maple the quicker. But this tree, planted closely (these are eight feet apart, and their branches touching), would evidently form magnificent farm wind-breaks. With proper interspersions of such sixty-foot walls, or walls even of trees of much lesser size, the snow would be level all the winter long on field and path, the gentle and soft-handed protector of the young winter wheat, the smooth support of the rapidly gliding sledge, rapidly gliding, as it might, to its journey's end, while the farmer sits jovially behind his rushing team, and the smoke of the fast-passed cottage rises uprightly through the white and frosty air.

I remember one Christmas, some five years back (it was on a broad and sloping mountain side, cleared for many miles of its forest by the woodman's art, as closely as if some gigantic razor had shaved the land), a party of us waited our Christmas dinner till our invited friends, two miles along the town line road, should arrive. They arrived, having taken four hours to drive the distance, four men walking in front, wet through, breaking down by main force the five foot drifted wall of snow, which the horses would never have plunged through without splintered pole or broken traces. Wind-breaks would have saved it all, and if general would save millions of dollars' worth in Ontario every winter, in delay, horse-flesh and waggon mending.

There is an instance on this same farm which clearly proves how rapidly a poplar wind-break can be secured. Here is a lengthy row of younger poplars, planted but seven years ago by Mr. Sing himself. They are quite fifty feet high, strong, thrifty, upright, and showing every promise of rivalling their seniors at an early day. There is little doubt that these are firmly rooted and strong trees, since their lofty tops arise, straight and unbending, right in the face of every north-east breeze that sweeps across the wind-tossed Georgian Bay.

On the same farm is another description of wind-break. This is an evergreen fence and, consequently, "always there." All along one side of the orchard stretches a row of balsam and of cedar, six feet apart, their lower branches closely joining where tree meets tree, spreading to a broader width on either side of the row and each—the balsam with its coniferous foliage, the cedar, a mass of curiously ornamented fringe-like leaves—rising in pointed cones, a long succession of green and brilliant pinnacles, forming as handsome and effective a wind-break as orchard need have or eye rest on. Planted twenty-four years ago, two feet high, and kept mulched.

The cedars are eight inches, the balsams a foot in diameter. The soil is sandy, the situation low compared with the mountain range, which stretches along the front, but high above the vast adjacent sheet of water in the rear.

Mr. Hiram Andrus, St. Vincent, makes the following statement respecting a most important matter, the class of trees to be planted by farmers in exposed and hilly regions. He says that in that locality, much of which, we should remember, is on the slopes of the Blue Mountains, the elm had better be planted than the maple. He pointed out many instances. "Here," he says, "these fields were cleared of the forest, to my knowledge, twenty or twenty-five years ago. These trees which you notice along the fence (they extended here and there for miles) were not left here purposely, but were small shoots

at the time of the clearing, and have remained, simply because the farmers did not keep their fences clean and cut them down, which they would have thought at that time good farming. Now that the country round here is almost totally losing its forest, what with one man's and another man's clearing, they begin to recognize the value of these trees for shelter, for shade, and, occasionally, for timber." There are many maples, seven or eight inches through, and many of ash nearly a foot through at the base—the maples often twenty, the ash thirty-five or forty feet in height—the former a good shade tree, branching out while near the ground into large and densely-leaved head, the latter taller, dividing into many long, separate and independently aspiring branches, every tall tree top with a chronic bend to the north-east, which testified to the severity of the winds on the Blue Mountains, on the highest slope of one of which we then stood. "We find here," said Mr. Andrus, "that on this high ground which has a hard clay sub-soil, the maple spreads its roots without penetrating deep into the earth. The elms, on the contrary, send down deep and solid tap roots. The consequence is that for the first few years the winds shake the hold of the maple on the earth, while the deep-set hold-fasts of the elm keep it firm in the ground. This retards the growth of the maple so much that the elms, as you see, are, in their twentieth year, twice as high as the maples. The difference is not so marked in the low ground; in fact, in the sandy loam of the valleys the maple grows as rapidly as the elm. There is, however, an advantage in possessing elm timber. This second growth elm wood is far superior to its progenitor, the great rock-elm of the Canadian forest. One tree stem when only five inches through will make four axe-handles, while the length next above will make double-trees and whipple-trees that nothing will break. Look at one of my axe-handles—it has stood the hard work of my wood-shed for a long time, chopping up and splitting great logs, and it is good as ever still. Why, it was put into a new axe, and has nearly worn it out, while generally an axe will wear out a lot of handles. Then what a beautiful polish the hand has given to the wood—it is smoother than glass—you never could get that on a hickory axe-handle. Now that they bend everything by steam and use only two pieces in waggon-wheels instead of a lot of felloes, this second growth elm would just do for them and for sleigh-runners, and a thousand other things. It would make splendid fences. Plant your young elms at the proper distance for posts, and when they are big enough fasten your wires along, and there you have fence, wind-break, and shade-row, all in one. Then when they are grown up (and they will grow if planted and taken care of, at least twice as fast as those you see here), any time you need it, by putting in a post or a stout young tree, you can have a fine log of second growth elm timber."

Mr. Hartman, St. Vincent, speaking of the loosening of trees by wind, said that he did not like staking them, as that always more or less injured the bark and tended to retard the growth, but that it was his practice every spring to tread a fresh sod firmly in round each tree stem, which he found produced a good effect. He mulched, he said, young trees by taking along a waggon load of wheat straw and laying under each tree a carpet of straw about eight feet square and six inches thick. This he found effectual.

Mr. G. Leslie, Leslieville, has some very fine specimens of the silver poplar which, planted twenty years ago along the road-side, are now immense trees, three feet through, sixty feet in height, their branches spreading thirty feet on every side. Here are also elm trees, eighteen inches through and forty-five feet high. It will be noticed that these elms are perhaps double the size of those described in St. Vincent. These are in a black loamy soil, formerly a swamp—[St. Vincent mountains a clay loam—while these were transplanted; the others, the natural second growth.] As for situation, both are along the road-sides. Here are also some large white birch trees, planted thirty years ago. They are, perhaps, two-foot six at the base and nearly as high and broad as the silver poplars. There are near them some red oaks of the same age, as large in stem, not as immense in spreading foliage, but still great trees. Here are also to be seen great avenues between high walls of English birch, a tree apparently not greatly unlike our own second growth birch of the Canadian forests, but of leaf smaller, and of growth more pyramidal; of the Canadian tamarack, a tall and pointed tree of pale green foliage—a strange foliage, needle-shaped in leaf, yet with an appearance sometimes cloudy, sometimes moss-like; and of the Norway spruce, tall, perpendicular, its colour a rich and deeply-darkened green on which the

eye loves long to dwell. All these planted fifteen years back, are over thirty feet in height and with stems often a foot in thickness. An odd peculiarity is here seen—the Norway spruce can be either hedge or forest tree. Here is a hedge, six feet in height, two or three feet through at the base, narrowing as it rises and trimmed to an edge at the top. The shears have kept it so; the trees are small, the hedge is a mass of small coniferous leaves,—it is a hedge and no more. You would say, "This is nothing but a hedge-plant," but every dozen feet, one stem has been allowed to grow and manifest its nature. No more a hedge-plant, it leaves the topmost border of its fellows, a stem six inches through, and rises erect a dark and cone-shaped Norway spruce confessed, full thirty feet in the air. The hedge, however, is dying, with too close cutting. It makes a good wind-break, the trees being given the room they need.

As you approach Leslieville you find a wooded neighbourhood. There is half a mile of the Kingston road each side shaded with large trees, planted in the public ground; and, north and south, a hundred acres extend, covered everywhere with young trees of a thousand kinds, interspersed with towering plantations, dotted here and there with mighty trees, the monarchs of the grove. When we learn that thirty years ago there was scarcely a tree in sight, we see that it is in the power of man, if he choose, in no long period to reproduce the forest.

The silver poplar spoken of above would evidently be valuable wherever it is desirable to rapidly produce large trees. Its timber, an unusual circumstance with the poplar variety, answers well for firewood. It is easily propagated from cuttings of last year's wood cut a foot long from above a bud to below a bud, and thrust nine inches into the ground. Although of very great value, farmers must be warned that it has, as have many of the poplar varieties, a tendency to run in the land, and throw up independent shoots, especially where cut by the plough. But these of course are easily kept down by care. I observe no such shoots near the numerous large poplars left standing here and on the adjacent roads. Mr. Leslie considers the fall the best time for planting.

Mr. Beadle, St. Catharines, states that when he wants seed trees of this description, (maples) he sends some one to gather it, different kinds being plentiful in the streets and adjacent woodlands. He plants these seeds at the time of their ripening. If this be in July, by fall the young trees can be transplanted. If they be seeds which do not ripen till the fall, they are then sown, come up in spring, and are transplanted when a proper size. Mr. Beadle has had much experience in tree-planting. Of the two, he prefers spring planting to fall. The cold winds of winter, he thinks, may sometimes dry the life from out a young and tender tree. The best security, however, is mulching, which is equally valuable in fall as in spring. Near his property are a row of maples—the hard maple of the Canadian woods—the sugar maple, prolific in remembrance of forest camp and simmering boiler, and of many a sap collecting journey. They are, he thinks, thirty years old, of a thickness of eighteen to twenty-four inches, forty feet in height and of spreading yet closely branched heads. The soil beneath both elm and maple is a rich and gravelly loam, somewhat, however, inclined to leach.

Mr. R. N. Ball, Niagara Township, possesses on his land several improvements of great interest to forestry students. This historical Niagara County, by the way, is studded with battle grounds and rife with interesting story. Here, as we pass at midnight, our horse's feet sound dull along the deep road cut in the mountain's face. Seventy years ago there was no road; but many found a path, and that a quick one, to eternity, for to the right we look by dim moonlight over the sharp sloping hill down which, with many a soldier slain, and many a scalp torn from the skull, amid the mingling din of musket shot, of Indian yell and Saxon blasphemy, the Union Jack, upheld by Pagan and by Christian hand, forced the Stars and Stripes into the whirling waters below. How rapid are earth's changes. A month ago, and these bare trees were myriad-leaved in vivid green. A century, and where the solitary squaw sells her paltry baskets, the land, from sunrise to sundown, swarmed with the powerful tribes of her dusky forefathers. High above us, through the dim night air, towers on the hill the monument of Brock, recalling the tough English schoolboy, victim of many a flogging, and victor of many a bruising match, in short time transformed into the stern British general, loved by friend and feared by foe, traversing land and sea to fight his country's battles in the distant wilderness of this

then savage land. Here again on that distant eminence repose the bones of the Butler family, those implacable refugees of '76, of bitter memory to every American born.

Beside his house Mr. Ball has a fine elm, planted by him, a sapling taken from the forest thirty years ago, and now seventy feet in height, its branches extending from side to side nearly another seventy; its trunk, a mass of solid timber, nearly thirty inches through. Here is also a walnut tree, its branches laden with the ripened nuts, but twenty years of age, yet with a stem of fifteen inches, a height of sixty feet, and a spread of trunk as wide.

Here is one of the best specimens in Canada of what may be done in evergreen wind-breaks. Fifteen years ago Mr. Ball had seven hundred and fifty young pine trees taken from their forest bed and planted on his farm. The method in which this was done is interesting and gives a valuable example. Earliest spring was chosen, on a day when the ground, thawed from the winter frost, had again frozen an inch in depth. The earth was cut around the young trees, leaving a circle of about eighteen inches across, thus lifting, in the then state of the ground, a disc of earth and root with each tree of two to four inches in thickness. Out of this great number of trees but five failed to grow. They are now nearly forty feet high, their lower branches spreading over thirty—many stems a foot thick—a long succession of cones of living verdure, brilliant with darkened green.

Some miles away is a remarkable self-sown wood. This originally was a forest of that timber of which Canada once had so much—the white oak. The forest across the road, extending to the shore, is yet of that character; many sturdy oaks being still there, though the fine merchantable timber—the long, straight, clear trunks are gone, carrying passengers over many an ocean, strewed perhaps in wreck on many a shore. Intermixed with the oak forest were some mighty pines, and when the land across the road was cleared, the pine seed, scattered by wind, covered a portion of the upturned ground, and the land not being ploughed again, a young forest of pines, perhaps three acres in extent, have sprung up and have thriven, standing as close as they can stand and live. This was eighteen years since, and they are now nearly fifty feet high and have killed one another out till they now stand six or eight feet apart. Here the process of the formation of a dense forest may be clearly observed. The under-branches, deprived by the density of the foliage above of the rays of the sun, are dying and dropping off, the stems being now bare frequently for twenty feet in height, the broken ends showing where branches have been. Up at the top all is green and vigorous. This process will now continue, the falling branches every year leaving a greater height of trunk; many of the weaker trees also dying out to give the others room, till there will remain a dense forest of great pine trees a hundred or even a hundred and fifty feet in height. Nothing is wanted evidently, from this and other examples, but to plant trees thickly and let them grow as they do in the natural forest, striving ever for height, and prevented from lateral extension by the discouraging shade. These trees, many of them now with stems a foot thick, are fit for beams, and would, in five years' time, yield a good supply of boards. But to get the great trunks, the tall, clear, valuable timber of our forest pine, would need a longer period. The example shows, however, with great plainness, how easy, with care and time, is the reproduction of our pine forests, and how soon we would begin to reap the benefit, for much good timber might now be thinned from the grove just described, and the plantation be all the better for the loss.

Mr. Ball, whose success in planting and opportunities of observation entitle his opinion to great weight, says that for wind-breaks one row of pines is better than two, as the trees, with light and air all around, will branch out strongly in every direction, while in the double row the inner branches touch and die as if in a dense forest, the outer branches remaining vigorous, and the attempt at growth in this divided direction does not seem so friendly to the tree. Instances of this were plainly to be seen, for here are both double and single rows, the single row evidently now, after fifteen years, as good a wind-break as the double.

On these farms is still much woodland. "Here," said Mr. Ball, "are yet two hundred acres of the original forest. At first cattle were not kept out, and did much injury to the young trees, but for the last twelve years they have been rigidly excluded, and you

see the result." It was a beautiful forest, dark with heavy trunks below, bright with red and yellow foliage above. But the undergrowth was superb; protected from the cattle and from the seed-destroying hog, the young trees had sprung up everywhere, close, fresh, luxuriant, thirty feet in height, an endless wealth of crimson leaf and shining stem. There the young red oak waved its great leaves, pear-shaped and serrated; there was the beech leaf, prosaic and common till you examine how beautiful the mathematical straightness of its crossing fibres. There stood, in thousands and in tens of thousands, young trees of the white ash and the black, the pine, the ironwood, the whitewood, and almost every tree indigenous to Canadian soil. "We need never thin them," said Mr. Ball; "nature will do that; the fittest will survive till a tall forest takes the place of the close undergrowth. But it is time," he said, "that the largest trees of the original forest were cut; if longer delayed their fall would injure many young trees which, in their present flexible state, would not be nearly so much exposed to injury." There are many young seedlings—oak, ash, maple, each with two large leaves developed, pushing, half covered by the leafy *debris*, their infant way from out the virgin soil.

It may be remarked that when hogs are let loose in the forest they eat, in preference to all others, the acorns of the white oak, thus destroying the chance of propagation of this most valuable of trees.

On and near the property of Mr. M. Quinlan, Simcoe, are to be observed some interesting stages of wood-growth. Here was, partly along the forest, partly extending into some uncultivated fields a lengthy belt of young second growth timber of all sizes, but a great number of them twelve feet high and nearly two inches thick. By far the greater number of these are maples, but here is the white ash, here and there an elm, and here a youthful poplar, stripped by the October winds, stands upright, a tall and tapering lance, clad in yellow bark of beautiful smoothness. There are hundreds of thousands of young trees. Mr. Quinlan states that the place has been perhaps fourteen years protected from cattle, and that these trees have sprung up since, the larger at first, the smaller later, in all cases, no doubt, by means of seed blown from trees near at hand. The soil is apparently a clay loam of some richness.

A row of pines, planted over thirty years since, are now pointed out, their stems from a foot to fifteen inches in thickness, their topmost limbs thirty-five to forty feet high. They have been perhaps twelve feet apart, the lower side branches have long touched and encroached on one another, but in every other direction the trees had room to grow, and were exposed on all sides to sunlight and to wind. They have grown consequently in a very different manner to those instanced at Niagara by Mr. Ball, which thickly planted and surrounded on all sides by their fellows, straining towards the life-giving sunlight from above. Here no lower limbs fall, each tree is distinct, a pinnacle of branches; but to grow, to flourish and to produce the good pine timber of the forest, it is evident the forest contiguity is required. These trees, thirty or thirty five years old though they be, show no signs of making timber as did the close, self planted grove observed near Mr. Ball's. There a tall stem was in process of formation, and clearly destined to grow taller still. Here the up-drawing power of surrounding branches absent, growth appeared almost at a standstill, so that these trees, though double the age, would scarcely have yielded each by each as much timber as the far younger specimens in the Niagara Grove.

North of these is a smaller growth of hemlocks, their sombre foliage darkening the prospect. They are of size not greatly different from the pines just described, save that the cone shape is less pronounced; they stand, like them, in sturdy independence, and, like them, appear to be of slower than the forest growth. Instancing some seen along the road, Mr. Quinlan remarks that elm grows much more rapidly than the maple. "These," he said, "are water-elms. Many rock-elms were planted, but were one by one cut down to furnish strong young timber for axe handles and other purposes." This corroborates, as we may observe, the opinion of the Blue Mountain farmers as to the desirability of planting this tree, and of the usefulness of its wood.

Within the limits of Barrie is a large grove, a goodly number of acres in extent, formed of beautiful, though scattered, second growth pines, containing many well-developed trees, from thirty-five to fifty feet in height, and from nine to eighteen inches at the base. The earth is a sandy loam of good quality. Crowning a long and elevated

ridge, the bright sunlight mingling its green masses with silvery gleams, this little forest is, from some of the near and lower streets, an object of great beauty. Judge Ardagh, in whose charge the property now is, informs me that thirty-five years ago a dense, tall and principally hardwood forest overspread this and much more of the surrounding land. The original forest is completely gone, and has evidently been succeeded in that period by the present growth.

Mr. D. James, Yonge Street Road, has, within the last ten or twelve years, planted many trees, both native and foreign, and has met with excellent success. Bordering the road at the entrance stand a hundred and twenty-five young pine trees, eight feet apart, many of them fifteen feet in height and seven inches through in stem, sturdy trees, all clear of bark and spreading of branches, full of promise of grateful shade beside the dusty road in many a sultry summer day to come. These trees were taken from the bush when a couple of feet high, about a mile to their present position. Mr. James states that he had taken great care in each case to bring a large ball of earth around the roots. This is, he says, far more necessary in removing trees from the forest than in the case of those obtained from nurseries, as the roots of the forest sapling are few and spreading, those of the nursery seedling more numerous, close and compact. They were planted very carefully, about the 24th of May, mulched for two years and have been carefully protected from cattle.

Mr. James has also a long row of Canadian spruce, balsam and tamarac, taken from the bush nine years ago. Many of these are three inches thick at the stem, ten feet high and spreading well. They have been several times topped—the highest shoots being cut off—but for this they would have been fifteen feet high. The operation, it seemed, in this case, had rather kept back the general growth of the trees. When we compare them with the pines just mentioned we find that these are but three inches, the pines seven inches thick, yet the pines were planted but one year before them. My reader will remember some pages back, in speaking of the Norway spruce at Mr. Leslie's, the effect of the pruning shears was noticed, as having dwindled the evergreen into a small hedge-plant, while great trees of the same variety, simply differing in being untouched by the shears, sprung up tall and stately at regular intervals along the artificial hedge. This row was planted in November. There are also here long lines of the Norway spruce extending in various directions. These were purchased from the nurseries, small plants about six inches in length, set out in a plot for five years and thence transplanted to their present position where they have been growing for five years more. They now average ten feet in height and seem prospering and to prosper.

There is here, too, a small plot of maples, hard, soft and silver, ash, water elm, rock elm and basswood. These have been taken from forest ground four years ago, stout walking-sticks in thickness, and four feet high, the branches completely cut away and the roots left as numerous as might easily be dug. Their growth has been rapid; they are in height twelve feet and over.

The large farm of Snell Brothers, Edmonton, affords instances of several descriptions of tree culture, and I would wish my readers, who have wood lots yet remaining, to notice the instance of forest preservation.

Close to the house is a hawthorne hedge, 12 feet high, extending parallel with the lane leading to his house. Though it is a hundred feet from the lane to the hedge, the latter forms in winter a wind-break sufficient to keep the snow from drifting into the lane, and consequently, as Mr. Snell remarks, "our lane is nice level snow when every body else is digging big snow-drifts out of theirs."

Near at hand is a row, half a mile in length, of fine maple trees. Mr. Snell planted these twenty years ago. These were taken from the forest in a light sandy soil, and planted in a clay. They are planted about fourteen feet apart, are thirty feet high, the lower branches spreading fifteen feet, their stems a nine inch diameter; they were planted in the spring, but it may be noted, were never mulched, gaps in one or two instances of fifty or a hundred feet, occur in the line. These, it is to be noticed, are on lower ground than the rest. An under-drain would probably have preserved every tree; it is probable also that, had these trees been well mulched for the first two years, they would now be of greater size; and it may have been that the additional vitality thus secured would have

preserved the whole row, despite the weakening influence of the lower land. This row, in summer time a tall and long extending bank of wavering green, gives the traveller, parching in his waggon-box under the sultry sun, half a mile of grateful relief, to secure which many farmers travel by this, although it may be rather a longer road. Why should not all our roadsides be similarly protected?

In this section, at all events, they are not unlikely to be. Farther on is a mile of more youthful trees of Mr. Snell's planting, four years in age, eighteen feet in height by about six feet in spread and three inches in stem; neither were these mulched, but Mr. Snell says they would have been of better growth had he done so. He had, he remarks, planted a number of others a year ago on high, dry and often-ploughed ground, which would, considering the state of the ground and the seasons, certainly have died but for the thorough mulching he had given them. They had all done well. In other instances it will be noticed that maples, when mulched, have done much better. I would, however, like to press the point that a slight stirring of the ground, by the hoe, spade, or cultivator enough to kill weeds, but not deep enough to hurt the roots, done say twice a summer, will bring trees on better than all else. Outside the circle of roots, (which is larger than the branch circle, you will find as you dig) you may dig deeply, and enrich if you choose, preparatory to the young roots coming that far. If you give trees care, they will respond to your exertions like living beings; if you give them none, they can be as slow and sulky as any labourer with a grievance.

Mr. Snell states that in planting trees along fences there was frequently more danger from the farmers' cattle inside than from the wandering cattle outside the fence. There should be no danger, he said, outside, for cattle should, in every township, be prohibited from running at large. Concerning the animals inside, all will seek the fences, sometimes that they are the most sunny, sometimes the most shady places, and while there, sheep, cattle and horses will unite in destroying the young and tender trees. Even if the pasture be rich and they have no desire to nibble the young and tender bark of the trees, they will, by leaning or rubbing against them, effectually check the sapling growth.

A little further on is the summit of a shelving bank which surrounded a beautiful and sylvan lake, its placid waters glittering dark and cold in the waning autumn sun—its waters the arena of an amphitheatre—an amphitheatre not surrounded by successive benches of interested spectators, but by successively rising terraces of tamarac and balsam, pale in ethereal pink, or darksome in sombre green.

Not all surrounded—everywhere the hand of the obtuse chips the nose off the statue—even here, by this quite lake, is an instance full obtruded on our view, along a lengthy stretch the opposing bank is treeless—a barren contrast to the rest. "The owner opposite," says Mr. Snell, "has cleared that bank, and has unfortunately done much to mar the beautiful surroundings of this pretty lake, while as for actual benefit from a farming point of view, he has achieved nothing. The land is poor and sandy: culture will never meet with a remunerative return."

Farther yet is a forest, rich in undergrowth and plentiful of young and thriving trees. Here may be seen in full and opposite view the difference between the sapling of the forest and the sapling of the field. Here is no longer the maple, no longer the ash of the roadside, stout, many-branched and square of stature. Here, beneath the tall and embowering branches, rises the young maple scarcely more than eight inches at the base, shooting upwards in sheer and twigless pillar, dark-grey of mottled skin, seventy feet of height and more, till its topmost twigs may burgeon into head whence sun and air may feed the trunk below. Here is the beech, almost equally tall, slim and branchless, pressing upwards, instinctively aware that its life depends on attaining the sunlight above. Here is the yellow birch, scarce three inches through, forty feet in height, destitute at this season of foliage, on its few and scanty projecting limbs, and appearing, where a streak of sunlight falls upon its polished trunk, like a slender and rounded pillar of shimmering and dusky silver. All around everywhere down the forest glades, visible from our carriage, rises many another youthful tree—the elm, the ash, the oak—lofty and beautiful, six-inch stems every one, all emulously pressing to the light and life above. Every here and there stand the huge and older trees, but sparsely scattered; for this twenty-five acres has for this score of years yielded annually its thirty cords of fuel to stove and fireplace, and

will probably continue to yield as much; for the process of reproduction is being continued in full vigour, and the forest earth is dotted with little seedlings springing up, ready to be trees in turn.

This piece of woods affords a good example of the manner in which the forest can be preserved if care be taken. There are two ways of preventing cattle from destroying the forest; one is to fence them out, the other, to keep their pastures rich. Cattle have always had free access to this piece of woods, but the adjoining fields where they pasture have always been kept in heavy grass, the cattle never being allowed on the pastures in spring until a rich growth has appeared. The consequence has been that the cattle have gone through the wood when they chose, without any inclination to feed on the young trees. It will be observed that patches of woodland so kept are not so liable to suffer loss by wind; the trees originally left at the edge, their trunks weakened by the force of a sun to which they were unused, would fall, but these could, either before or after being blown down, be removed and used for firewood. The young trees springing up round the borders, and growing up exposed to the sun, acquire the form of the low and many-branched tree of the open plain, which will not itself blow down, and acts as protection against sun and wind to the older trees behind it. But we must remember that, if cattle, anxious for food, had been permitted entrance, they would have destroyed these young surrounding trees in their infancy.

Some evergreen trees in the beautiful ornamental grounds of Mr. Elliot, of Brampton, afford an example of an unusual kind of planting, which was indeed far too expensive for ordinary practice, but succeeded very well. These trees, mostly pines, when twenty feet in height, were taken from the bush in winter time, a large mass of frozen earth, some feet in width, being taken with the roots. They were then transported to the place where they now stand, planted in an excavation suitable to their size, and all vacant places well filled in with earth. It was found necessary to stay them strongly, or the wind would blow them over; but this precaution taken, they thrived well, and are now over forty feet in height—magnificent piles of winter foliage.

Mr. Elliot states that, in transplanting evergreens, farmers would, according to his experience, do wisely, to go to the forest or rather to its edge, trees from thence being far the best, in spring or fall; select small plants, one or one-and-a-half feet in height, carry them home by the waggon-load, and plant them close together in rows, in suitable localities, establishing there, in fact, a sort of nursery. These can, then, after one, two or even three years, be planted out to far better advantage than those just taken from the forest. Mr. Elliot also remarks that, in transplanting trees of good size, a very frequent cause of failure in growth was the heat of the sun striking on the bark of the tree at its southern side, which seems to injure the vessels of the bark and of the wood behind it. This can be very well guarded against by protecting the south side of the tree, for a year or so, with a couple of boards nailed in a V shape together.

Mr. William Clark, Scarborough, is of opinion that disforestation has gone too far, and has been for some years doing what he might in replanting.

In his walnut nursery he has three hundred fine young saplings in their fourth year of growth from the nut, averaging about nine feet in height and one-and-a-half inches at the base. In this rich soil their growth is so rapid that last summer alone some of them have thrown out fresh shoots six feet in length. This rapid growth Mr. Clark accounts for by the statement that two years ago, in the second year of their growth, he had with a long sharp spade cut off the deep tap-root of each, thus turning the energies of the tree towards improving its surface roots, which, lying in the richer soil above, send back a better return. Opinions differ. Some say, "take care, above all things, in trees which have these deep roots, to preserve them." It appears to me that their principal use may be to steady the tree, and that where the shelter of groves renders this unnecessary, they may be advantageously cut. It certainly assists lateral growth. The experiments should be tried side by side.

"I think, also," said Mr. Clark, "that my walnut trees thrive better than do those of some of my neighbours, owing to the fact that I sent to Kentucky for my walnuts, while they used the more easily obtainable Canadian variety. These walnuts we will shortly set out in the places where they are permanently to grow. If, however, I were

doing it again, I should plant the nuts where I needed the trees, as I consider they are better without transplanting. I must, however, remark that in this small nursery it is easier to keep squirrels away from the planted nuts than if they laid along stretches of fence or other distant parts of the farm. When food is scarce in the woods, the squirrels come to the fields, and there is, though the nut be buried, still an odour which rises to the surface, and informs the hungry squirrel where, by tearing up the soil with his sharp claws, he may find food."

"On a long sharply sloping hill face near by," said Mr. Clark, "as the declivity is too steep for ploughing, and the land is therefore of little use, I have planted horse-chesnuts." These are doing well. They stand about eight feet apart, taking three to go down the hill, being about a hundred in number, and being now twelve feet high, large and spreading, will in a year or two cover the face of the hill with a densely standing wood, valuable as a wind-break, as a shade, and for many other purposes.

Mr. Clark has some hickory trees, twenty years from the nut, now fifteen inches through at the base and forty feet high. These are not the shell-bark hickory, which produces the ordinary hickory-nut loved by the juvenile, and by some who are not juvenile, but the bitter-nut hickory—a variety of nut far less edible. It grows equally well, and its branches are far safer, in many situations, than those of the more edible kind. In shape, when grown by itself, it is taller and less spreading than the maple, the shape of the mass of maple foliage approaching a sphere, that of the hickory, of this variety, an upright cylinder of half its width and once and a half its height.

Here are some butternuts, planted twenty years ago, of which one row in the damp ground of the lower part of the hill are fast dying, while another, higher up the bank, shows no symptoms of decay. They need, as this experiment shows, the dry ground.

He has also carefully fenced off, scarcely visible above, a long narrow strip of soft and mellow earth, above which rise a row of tiny points of darkish red. "These," he said, "are the soft maple. They are scarce in the bush, and I sowed these this summer; in a year or two they will be fit to plant out. We find almost invariably that the hard maple saplings, easily procurable in our forests, and which we generally use for roadside planting, refuse to thrive and shortly die in the wet places. The soft maple, however, will flourish there, and for this purpose I raise it."

Mr. Clark has planted many trees in this vicinity. He points out one row of maples by the roadside, only three years planted, a full mile in length; they are now twelve to fourteen feet in height and seem to be in every way successful. "Trees I plant," said Mr. Clark, "rarely fail to grow. My method is—in June to go to the bush, select such young trees as appear most fit for my purpose, and, with a sharp spade, cut a circle round the tree, about eight inches from the stem. I tie a string round the tree to know that its roots are cut, and mark a red chalk cross on the south side, to plant it as it stood. I then leave it till fall, when I take the waggon and go for my trees. By this time the summer's growth has started fresh roots inside the circle, and the young tree, properly lifted with a spade, will come up a mass of earth and roots which will cling together, and grow without fail. Some say, cut a rather larger circle when you take them up, to save the little roots that sprout at the ends. This is needless, for the original roots will die back an inch or two, and all new roots will grow inside that. Then, taking all the earth I can, and planting at once after digging, filling up with soft loam, not hard chunks, and mulching well afterwards, the trees will grow if mice and cattle can be kept away."

Not far off is a splendid row of young maples, planted by Mr. Macklin, Jr. These are set out but five years, and have made twice the growth of many for the time. They are twenty feet in height, nearly fifteen in spread, many six inches in stem and present a splendid appearance, extending the full length of the lot along both concession and side lines, as well as forming a long double avenue from the road to the house. The remarkable growth of these trees may be owing to the manner of mulching, which is peculiar. A surface of perhaps six feet in diameter, with the tree for a centre, was covered with pea-straw, and on this a number of stones, so close as often to touch each other, were laid. These at first kept cattle from disturbing the straw, added solidity to the earth, and prevented the roots from being loosened by the wind, and now form a sort of permanent

mulch, giving also to the ground beneath them that well known moisture and fertility often observed in stony pastures.

An instance of forest preservation is shown by a piece of hardwood forest owned by Mr. Clark. "About four years ago," said Mr. Clark, "I bought this piece of forest of Mr. Snider, M.P., of Owen Sound, and for about three years I have kept cattle out." As a result of this, on all sides the undergrowth is springing up in its pristine beauty, a yard and more in height—a miniature forest of little stems, half an inch in thickness, at this season divested of leaves, giving us full opportunity to observe their differing varieties of bark, each rich and fresh in smoothness and in colour, as when their prototypes in Eden first sprang to life at the Creator's call. Here is the linden, immortalised by Landor, a darkish olive slightly specked with red; diminutive, faint and numerous upright streaks, marking where in later years the deep indentations shall divide the surface of the great basswood. Here are little beeches, white and blue, but on the surface, the first a smooth and greyish green, the latter redder in colour and already inclined to roughness of bark. Here is the black ash—a beautiful stem of yellow grey—the white ash, dark and smooth like mottled whalebone—the ironwood, a purplish umber, its future bark appearing on the speckled skin, like little wave-marks now; and the elm. Whatever mistakes you may make in the forest, there is no mistaking the young elm—its bark, even when the tree is scant half an inch in thickness, standing out in such full relief, as if a multitude of diminutive serpents, climbing the tree, had been turned to wood in the effort. Here is the hickory, smooth and dark, spotted with reddish dots; and here are maples more than all the rest together.

Mr. Clark observes that "here is ample material for the reproduction of this forest; but look over the fence." There stretches another forest, but how different. There are indeed many trees; high, large, and upright, but with a dying and a spectre look. They are old trees, and there is nothing but old trees. No youthful maples, tall and slender, emulate the growth of the ancient trunks; no reproducing undergrowth surrounds their base. All is bare, a sheer carpet of brown leaves is on the earth; leaves and nothing more. Not a little twig; not an acorn is throwing up its double leaf; not an elm is rising through the soil with its upward and tremulous shoot. All is smooth. When the great trees, surely going, are gone, the forest is altogether gone. How different to this side of the fence. Here is life and the promise of many a life to come; this forest will endure for ever; that, for a few years. Whence is the difference? Cattle have been let in. The owner has fed his cattle on the young shoots of the forest, he has gained a thousand pounds of meat and lost five hundred cords of wood, and he will shortly lose for the rest of his farm that living fertility which the adjacent forest surely gives. "When I came here," said Mr. Clark, "nothing but forest was to be seen; now there is little but field. I was a chopper in my youth, as were my neighbours, but I see what we have done, and I have for years been a planter of what trees, and a preserver of what forest I could."

Near here is the farm of Mr. Rennie, who has obtained a gold medal for the best kept farm of a large district of country. Mr. Rennie tells us that having squared up the edge of a portion of forest, much of it had blown down. This was probably from the loss of the young trees which had grown at the edge, with spreading roots and stems accustomed to the sun. Such trees, encouraged along the border of the forest, are the glacis of its fortification; parrying and turning above the heads of the inner trees the driving winds that would otherwise uproot them from the soil, and keeping the sun from their stems, and from their partially exposed roots.

Mr. Rennie has a thriving young orchard of about a hundred and twenty trees. This is surrounded on three sides by one of the finest wind-break of Norway spruce to be seen. It is over thirteen feet in height, spreading at the base to six feet, the stems five inches—a long, dense, and carefully trimmed hedge of light green—a bright line against the autumn landscape of dark clay ground and far and fragmentary forest. Mr. Rennie planted these flourishing Norway spruces eight years ago in the spring, obtaining the plants from a nursery. They were planted three feet one inch apart, the ground being made, the year before, as soft and mellow as a garden. It is remarkable

that where this was not done to a sufficient breadth, and sod had to be turned up, trees did quite as well on the freshly reversed sod.

At the farm of Mr. Macklin, senior, within some miles, are some fine tall rows of tamaracs twenty years old and twenty-five feet high. Some of them, however, are not flourishing, and Mr. Macklin says that he would not advise any one to plant tamaracs except on damp ground. They are likely, he thinks, on dry ground to die. He has here a splendid Norway and Canadian spruce, planted side by side fifteen years ago. The Norway spruce is now over thirty feet in height, the Canadian, twenty, each having a spread of fully twenty feet, and a stem over a foot in thickness. These are on high ground in front of the house, a dark clay loam. Mr. Macklin, jr., is of opinion that something should be done to preserve what portions of bush are yet existing. "I have," he says, "fifty acres of bush land, one of the few bush lots yet left round here, and if there were any inducements given, I should like to preserve it in forest, but it is destined for my farm, and I shall have to clear it. Others are similarly situated."

J. E. Gould, Esq., near Oshawa, states that the country is becoming thoroughly deforested. Near his place, however, still ten or twelve acres remain of the original forest. "Cattle," said a farmer, who in an adjacent field was helping his hired man to saw a great fallen basswood into four foot lengths, "have been kept out of that piece of bush for twenty years."

About ten years back this forest had apparently been culled of many large trees, the rotten stumps of which stood here and there. But it was still a pretty piece of woodland. Everywhere stood the tall maple, the basswood, the ash, the elm—everywhere was the goodly beech, twenty inches—two feet—thirty inches at the base—rising in mighty beams sky-ward, to the branches above; while all around and everywhere between were young trees nearly as tall as they, but at the base only six or seven inches through, ready in a short space to take the place of the larger ones. All of this patch was covered closely with excellent undergrowth, ash and maple, beech and elm, some just rising from the ground, many ten or twenty feet high. There was little sign here of falling timber, the tall undergrowth preventing the thorough sweep of the winds. This patch left to itself might produce timber for ever. This is not however its destiny. Our basswood-dividing friends outside tell us that the owner is about to cut it down and sell the whole mass for firewood.

Along the road in front of Mr. Gould's residence is nearly a mile of road-side maples, twenty feet apart, doing excellently well. Between one and two hundred of these were planted seventeen, the rest thirteen years ago. Of all these hundreds not one has missed to grow and flourish. He describes his method of planting. It was done in April, the trees were taken from the forest by cutting a circle round them, fifteen inches from the tree, through the roots. One man then took hold of the sapling and bent it over as far as possible, while another with a sharp-edged, long-handled spade separated the roots from the ground below. The mass of small fibrous roots being under the centre of the tree—extending, perhaps, eight or ten inches laterally, and going six or eight inches below the surface, it is important to preserve; and in the cutting operation this was, as far as possible, endeavoured to be secured. In planting, a hole three feet wide and perhaps fourteen inches deep was dug, the sod thrown to one side, the earth to another. The bruised ends were then cut cleanly off the large spreading roots, some fine earth, perhaps two or three inches in depth, thrown back into the excavation and the tree stood upright therein. The long spreading roots were never allowed to bend, but were cut off so that they should lie straight. Three or four inches more of fine earth was thrown in and the tree was then lifted and lowered once or twice slightly to shake the fine earth to place around the roots—an operation which was completed by pressing with the hand the earth as closely among the roots as possible. The rest of the earth was now thrown in round the tree, which was placed at about the same level as it had occupied in the forest, and the whole tramped in with the foot; the sods were then scattered above. All these trees, it must be noticed (and it is, in Mr. Gould's opinion, a very important part of the operation) were chopped off to about eight feet in height, many of them having previously been double that length. Care was taken to cut very slantingly, so as to cast the rain from the top of the stub. No care was taken as to the small branches, as the main dependence is not

on them, but on the new branches which will spring out near them. These trees were all planted a little more than a foot from the fence, so that cattle could not press between them and it. The earth was the natural sod, as, so near the fence it had never even been ploughed. About the first of June, a team was sent along loaded with rotten barn-yard straw and litter, about a wheelbarrowfull of which was thrown as mulching round each tree, giving perhaps six inches deep and six feet diameter. This, says Mr. Gould, rots and kills the sod. For the first few years in winter care was taken when the first soft moist snow fell to tramp around these trees. This then froze solid and prevented the mice, whose habit it is to work under the snow, from girdling the trees.

As has been noticed, all these trees grew well, except indeed at one point of low land. A drain was cut through, but did not save the maples, all of which at that point died. Soft maple would have answered here. The seventeen year trees were ten inches, the thirteen year, seven inches at the base, thirty-five and twenty-five feet high respectively, and with very well shaped heads. Some say that bending the roots makes the branches twist awkwardly, and I saw near here a row of maples large and old, which I was told had been so treated; the branches were strangely crooked. The soil here is rich clay loam. It is very observable that the roads drift less with snow where Mr. Gould's maples border it, but for this purpose they would be better closer. A farmer near had planted about the same time and carefully, 150 maples without shortening them. The wind then shook them and the consequent loosening of the roots killed many. The snow was tramped, but not at apparently a proper time, and the mice girdled more. Moreover they were never mulched. There is scarcely more than a dozen left.

Of noticeable trees planted here, the white ash has grown in forty years, fifty feet high, fifty in spread, and two feet six inches at base. Soft and hard maple of the same age are each about sixty feet high, but the hard is but fifteen inches in diameter, the soft full thirty; its head, also, double the size and density of that of hard. This is on land quite dry enough for the hard, in the lawn in front of the house. Elm, basswood and maple sprouts, growing up wild in the fences were trimmed here twenty years back. They are now sixty feet high and eighteen inches through. Second growth pine, self-sown, forty years, will now square nine-inch lumber forty feet in length. A walnut tree thirty years from the seed, is a very handsome specimen, fourteen inches through, thirty feet high and twenty in spread. Mr. French, its owner, advises to plant walnuts with the burrs off, in the autumn, as soon as they fall by the frost, without letting them dry.

A wind-break has been planted north of a house here by Mr. Gould, of Canadian spruce from the nursery, nine feet apart, planted May 16, 1868. They are now twenty-five feet high. All lived and did well, and serve an excellent purpose. Mr. Gould would, he declares, willingly give a hundred dollars for such a one north of his present house. In this instance a mark was made in the nursery on the south side of each tree, and that side replanted to the south. "When I was planting trees," said he, "I offered my neighbours to team all they would need from the bush if they would come and help plant; but they would not. If they had, we should have had far more trees, and their farms would have been worth much more." He is of opinion that trees need no watering, but that stirring the soil on the surface deep enough to kill the sod, but not strike the roots, will give all the moisture needed.

Mr. French remarked that since the woods have been cleared, the springs are drying up, and all the wells which could not formerly be dug deeper than fourteen feet on account of the abundant water pouring in, now are dry and have to be deepened to thirty, forty, or fifty feet.

T. C. Patteson, Esq., Eastwood, Oxford, has some hundreds of acres of woodland, forming a park in Ontario probably unexampled for beauty. It would be valuable to our purpose to note the process by which this has been obtained. It was a region of immense hemlocks, intermingled with many a deciduous tree—hemlocks no longer seen in their original grandeur. Felled for the sake of their bark, their giant trunks everywhere lay prone and dry among the green undergrowth. The present owner is rapidly removing these, clearing away old, unsightly and rotten trees, and opening in all directions charming vistas through the forest. But the trees left here and there, especially on and near the beautiful meadows of rolling land

passed in approaching the house, are well worthy of note. Where they have, as many have, been left at distances of fifty or sixty feet from each other, you will see maples, in the summer time immense cones of waving green, sixty or seventy feet high, and fifty broad, their lower branches coming within a few feet of the ground, forming magnificent specimens of what an ornament to the landscape this great tree becomes when given opportunity. There are here, on the meadows bordering the lawns, and everywhere through the great park which the culling mentioned has left the forest, thousands of such trees, intermingled everywhere with beautiful clumps of young hemlocks, perhaps twenty feet high and as many broad, their dark green contrasting richly with the lighter edging with which the growth of this year tips every branch. A drive through these woods, being now mostly, and soon to be altogether, of trees in flush of life and strength, everywhere passing openings where new specimens of forest growth are seen, beech and maple, elm—all the woods, in fact, but the maple predominating—is something to be remembered, and shows how beautiful a park can be made by carefully managing the original Canadian forest. Many pretty glades are here, fit:—

“For sportive youth to stray in,
For manhood to enjoy his strength,
And age to wear away in.”

There are numerous young cedars and hemlocks bordering the lawn, planted by Mr. Patteson some six or seven years ago, many of them ten to twelve feet in height. His method of planting evergreens is to take the trees from the forest when very small, say eighteen inches in height, between the 9th and the 19th of June. He has been very successful—rarely or ever losing one.

There are near here, on the road to Woodstock, two plantations of pine trees, about fifty years of age, planted by the Vansittart family. Many of these are now eighteen inches thick at the base, and would each yield a log a foot square of a goodly length; most of them are sixty feet in height. In the summer these plantations of pine near the house form excellent and shady retreats, being perfectly cool in the warmest weather.

Mr. E. A. Powers, Hope Township, Durham, states that the whole country is being very rapidly denuded of wood. It is selling now at \$7 a cord, and, an acre of good wood averaging between forty and fifty cords, the right to cut it readily sells for a hundred dollars, after which the land immediately produces a crop and consequently gives a rent. The consequence is that the country is becoming extremely bleak and cold, and much of the fall wheat is annually winter-killed; farmers are taking to coal, and in no long time, if reforestation be not adopted, farmers must depend entirely on the United States for their fuel. “The process of deforesting,” says Mr. Powers, “has been very rapid. Twenty years ago there was a square half-mile of forest close to me, and plenty of forest all round, but we all thought that there would always be plenty of timber, and we cleared it up. Now we are beginning to perceive our mistake. I have myself fifteen acres of forest yet standing, but it is pretty well culled of the best timber, and my father and my brother have the right to cut wood as well as myself, so that before our united needs the wood is fast vanishing. I have a field of ten acres in underbrush this side of it, as you see (we were then driving along a sleigh track through the underbrush in question).” Mr. Powers remarks that two slight ravines run diagonally across the field in question, joining within his fifteen acres of bush. This ravine is now dry. “You would not think,” said he, “that in this serpentine hollow ran once a babbling brook; but it was an excellent spring creek, fed by living springs at the heads of these little ravines. I cut down the forest, taking care to leave some small trees around each spring, but they proved of no use. As soon as the field was cleared the springs dried up, and retreated within the forest; it is now only there at the junction that I have water. If that were cleared up I should have none. To retrieve the mistake, if possible, I am allowing this field to grow up in underbrush, have kept cattle out for six years, and trust to see it again a forest.” The field is now pretty thickly covered with young trees in all stages of growth—maple, elm, birch, basswood, pine and oak—from the young elm, which had pushed through the ground last fall, and just appeared above the surface, to the thriving maple of twelve feet in height; the damp and fast-falling snow enveloping it and its fellows with a fleecy mantle till the field seems populated by grim and sheeted ghosts. “In ten years,” said Mr. Powers, “I shall again

have a forest here, and I think my creeks again." Near by is an isolated clump of trees at the corner of the farm. "Along here," said Mr. Powers, "I left a wind-break of two acres of thriving forest, birch, ironwood, elm, maple and beech. Grass, however, got in and covered the soil, and the consequent weakening of the trees, thus deprived of their original forest soil, caused many to fall before the wind. There is scarcely half an acre of trees left now, and they are all dying at the top." The cause of this is explained elsewhere. It is generally caused by cattle, who kill the undergrowth—then comes a sunlight and drying up which most portions of the original forest will not stand.

Mr. Lowe, close by, has twenty maples which had been set out in a double row, sixteen years ago, each side of the road to the house. They were saplings about an inch and a half through, the heads were slightly shortened back, not more than eight or ten inches, and the branches as well; they were not mulched nor the snow trampled to keep mice away. In spite of this, however, they have made excellent progress. They are now one foot through, forty-five feet high, twenty feet in spread and with very well shaped heads. This is, however, an isolated case—very few trees with such slight care appear to have thriven. This, as well as the farm of Mr. Powers, is clay loam.

Near here is an orchard belonging to Mr. Foote, the soil of yellow sand, three feet deep, on a clay sub-soil. Mr. Foote has tried for twenty years, but apple trees planted in that soil would not grow well till, four years back, he dug a number of holes four feet in diameter, put a cart-load of surface soil from clay land near in each hole, which it about filled, and planted a young tree in the centre. They did well, and he now has a thriving young orchard.

Mr. Dickson, connected with the management of the Union Cemetery, further on, states that for ten years they have tried tree planting there, the soil being much the same as that last described, but the sand more whitish. They have planted over a thousand trees, but the failures have been so constant that scarce a hundred are left standing, and they do not thrive well. Not much care, however, he thinks, in mulching and protection against mice, has been given them.

As a proof of how little knowledge is general in these matters, a gentleman on the road happening to mention that, largely in consequence of the exertions of Mr. Powers in forwarding the adoption of the by-law, 5,000 trees had already been planted in the Township under last year's Tree-planting Act, on being asked if they had this winter been protected from mice, replied, that he thought there was no necessity as mice would not hurt young maple trees. He had only to go to the next farm, Mr. H. D. Haskill's, to find his mistake, Mr. Haskill immediately taking a shovel, and removing the snow from some young maple trees and showing him where they had been very badly injured by the mice. Mr. Haskill has two hickory trees of the sweet nut variety, grown here from nuts brought from Wisconsin and planted thirty-seven years ago. They have grown nuts for many years, but although so old are of no great size, being respectively but six and eight inches through and fifteen and twenty-five feet in height. It is certain, however, that were these nut-bearing trees, whether walnut or hickory, planted in numbers and closely, they would make far greater progress than in isolated trees. Mr. Powers relates an instance which came under his own observation in Minnesota, a relative of his there having planted ten acres with walnut trees. The field was got into good order and furrows drawn across it six feet apart. The nuts were then sown thickly along all the furrows, and the plants, when they came up next spring allowed to remain as close as eighteen inches apart. These trees grew very rapidly, the cultivator being run between two or three times each season to keep down the weeds, and the numerous body of trees in the field acting as shelter to one another. Many of the trees are now nearly a foot thick, their trunks have grown tall, their principal light and heat being from above and the lateral branches being therefore few. The owner has sold, last year, the right to cut every alternate tree, for a thousand dollars, and values the remaining trees in the ten acres at ten thousand.

A thousand feet above Lake Ontario, where the Speed flows languidly among a succession of beautifully undulating uplands, lies the Model Farm, presided over by Professor Brown, in whose hands, among the other multifarious branches of an experimental farm, the important one of arboriculture is likely to receive due attention, since he himself is a European forester of experience, and is the son of Mr. John James Brown.

the chief Scottish authority on forestry, and the brother of the well-known conservator of forests of South Australia. Along one side of the lawn runs a shelter-belt of the Canadian balsam, black and white, and the Norway spruce, the three intermingling colours of darker, lighter and bluish green giving a beautiful effect, planted about ten years since, three feet apart, and now a dense hedge of twelve or fifteen in height, giving rise involuntarily to the thought, as one looks across the numerous fields and orchards here in sight on other farms, all undefended from the winter wind, "What a pity that these ten years are lost to all these. A little time—a narrow strip of land—that is all, and each farm and orchard might have had a similar one. Let us hope they will soon profit by the example."

Ornamenting the great lawn in front of the main building are numerous evergreens—Norway and Canadian spruce, Austrian, Scottish and other pines—beautiful masses of pyramidal foliage now, and destined to be better. These, though large trees fifteen or more feet in height, were moved here this spring, masses of roots and earth being brought with them weighing a ton and more. This was accomplished by cutting, last fall, a trench round each tree a couple of feet deep, enclosing a circle five or six feet in diameter. The trench was then filled in with straw, which, while allowing the disc to freeze, kept the frost from its junction with the earth below. In the spring the whole frozen mass was raised with levers and drawn on a sledge to its present position, where an excavation made in the fall was ready to receive it. Nearly a hundred were thus moved and none show the slightest sign of injury. On the lawn many flowering shrubs, classed in their families, are also planted. In the rear of the college, occupying the whole of a broad and far-extending slope of grassy ground, is a plantation of this spring now in its infancy, but destined to be of great ultimate value. Here stand, ranged at proper distance in their several classes, numerous varieties of oak and ash, of elm and maple, of, in fact, all the principal trees of the forest. These are flourishing now, and will, as the year rolls by, furnish valuable examples for guidance in tree-planting throughout Ontario.

Farther on an experiment in foresting, in which all are greatly interested, is being carried out. Here is an acre of young walnut trees, six feet apart each way, only four years since planted in the nut where they now stand, and many of them already seven feet in height, with fine full tops indicative of hardy growth, their long clusters of curiously-shaped leaves shining with yellow lustre in the afternoon sun. The soil is a good clay loam. The trees have grown altogether without shelter, exposed to heat and cold in a region where, from its height, both are necessarily felt to a high degree. This plantation is located in two fields, half on each side of the fence. It is in the shape of a square with a crescent-shaped indentation on each side, so that in each field cattle can find shelter on three sides. In a few years' time this clump will be very valuable in walnut wood alone; and it is evident that, if walnut can be grown profitably in this exposed position, it can in most parts of Ontario.

Some hundreds of yards off is another clump composed of larches, planted on a very gravelly hillside. The distance apart is the same as that of the walnuts, but, as was to be expected from the nature of the soil, they have not advanced with the same rapidity. Failures, however, have been repeatedly re-planted, and they will now average three feet in height. One of them—and one of the most advanced—four feet in height, is planted actually on the edge of the gravel ridge, growing apparently from a pile of small grey stones, among which its roots contrive to find nourishment. This plot is valuable for example, as showing that there can hardly be soil too barren or stony for these trees.

An instance worth noting in growth has occurred near Brantford, where, about ten years ago, in a good loamy soil, an enterprising farmer planted half an acre with pine, spruce, and hardwood trees intermingled. They are now about thirty-six feet in height, in remarkably good condition and form a splendid shelter. On good land in that locality all varieties seem to thrive well—as for maples, the hard on dry, and the soft on wet land seem to thrive whether the soil be rich or poor. "Those trees," says a Brant farmer, planted over a score of years have become fine trees; but like all those grown singly or in belts they grow spreading, not tall trees. The forest in one township here was magnificent, but the greater portion has been cleared. It was unfortunately found that the land, for agriculture, was almost valueless, and I believe that if planted now, it would, in

a few years, produce a revenue ten times greater than it now does. We are wont to hear of the great success attained by forestry in Iowa and other Western States. Having travelled through a large portion of that country, I am convinced that if they make it a success, we could make it one ten times greater. On the light soil of Charlottesville, in the county of Norfolk, I have seen walnut trees eight inches in diameter, which had only been planted that many years. Half an acre of native balsam planted here twenty years ago, closely like a forest, are thrifty, and from eight to twelve inches in diameter. Here, near Burford, are two kinds of soil, one being a gravelly subsoil. Trees do a hundred per cent. better on the other."

"A good many farmers," another Brant agriculturist remarks, "have left many oak and chestnut trees standing beside their fields, which I think a great help in preventing drought."

Near Cataraqui, one cultivator, Mr. John Simpson, has soft maples on stiff clay, sand, sandy loam and loam, and finds they do well on all these soils, but would prefer the loam. He has found the soft or swamp maple to give the most satisfaction, although the timber is inferior to that of the hard maple. They are so much more sure to live and grow so much faster. "Then," he remarks, "Their beauty of foliage, and their lovely crimson flowers in the early spring gives them an advantage over the hard maples." He has a row of these trees which were planted seventeen years ago, and has tapped them three times in the last three years with very satisfactory returns of sap. The syrup made from the soft maple grown on upland is believed here to be of better quality than that from trees grown in swamps. He has planted a great many hard and soft maples, and always expects to lose a large per centage of the hard, while his loss in the soft is trifling. His method of planting is to wait until the ground is moderately dry, dig a hole larger than the roots require and as deep as convenient, the deeper the better, then fill up to within ten inches of the top, placing the tree with the roots carefully spread out, covering with a few inches of mellow earth. Then throw in a couple of pailsful of water, fill up the hole, press down moderately, stake and mulch, and you have a tree that is sure to grow and do well. Mr. Simpson remarked that great mistakes are made in the selection of trees in getting them from thickets. He selects from the borders, always choosing low-set stocky ones, and avoiding the long, slender bamboo-like things, that require cutting off about half way down and then die off after all the trouble. Mr. Simpson intends going into the cultivation of black walnut, of which he has several hundred planted of different ages. He set out in the spring of 1883 over a hundred which have done splendidly, losing but one out of the lot. He has several hundreds more ready for transplanting. Mr. Simpson has, he believes, the only black walnut of any size in the county. It is eighty-nine years old, and seven feet six inches, four feet from the ground. This is an old tree, covering a large space of ground, and is looked upon as a great ornament, bearing large crops of nuts, from which he raises his trees.

Concerning staking, of which Mr. Simpson speaks, many object to it as hardening the bark where the ligature presses, and stopping circulation. A method is advocated of nailing a small board on top of the stake, with a hole bored in the other end through which the tree passes. The tree is got through the hole by splitting the board, and then fastening it together by screws.

Mr. Briggs, of Kingston, remarks, "That in that locality, spring planting for forest trees is generally preferred, unless for evergreens, which do well if carefully removed after spring is passed, that is, when done on a cloudy day, so as not to allow the heat of the sun upon the roots. In clay soil, in this section, where well drained, the hard and soft maple, elm, walnut, hickory, poplar, oak, beech, birch, butternut, locust, horse-chestnut, mountain ash, basswood, willow, silver poplar, black and white ash, spruce, cedar, larch pines and hemlocks have made rapid and healthy growth, but in similar soil when not drained, after five or six years the trees become unhealthy and stunted. In sandy loam they have nearly all succeeded."

In the part of that district which is as yet well wooded, little planting has been done.

Some rocky points and strips of land, useless otherwise, have, however, been planted with hard maple, which is growing remarkably well.

Mr. Muir, of Grimsby, thinks that forest tree-planting for regulating the climate is not required there as much as in other localities, on account of the many thousand fruit trees and vines set out every year. Mr. Muir gave the sizes and ages of some trees near him as follows:—36 years old in a deep sandy loam, some maples were over 6 ft. round, 3 ft. from the ground, while others were much less; one walnut of the same age was 7 feet round. Some others 26 years old, same soil, sugar maple, 3 ft. 8 in.; locust, 6 ft. 5 in.; birch, 3 ft. 9 in.; silver poplar, 4 ft. 10 in.; pine, 5 ft. 3 in.; ironwood, 3 ft. 6 in. Soft maples planted four years, same soil, are 1 ft. 3 in., 1 ft. 6 in., 1 ft. 7 in. Others on a high ridge of gravelly clay, twenty-seven years old—hard maple over 3 ft.; some of the same variety near them of the same age are very much smaller. Mr. Muir thinks that soft maple, elm, chestnut and walnut will grow much faster than hard maple.

“On high ridge land,” remarks a farmer near Sherkston, “the hard maple, walnut, pine, oak, white ash, linden, buttonwood, balm of Gilead and butternut; on the lower lands, soft maple, elm, black ash, birch and tamarack thrive best. In twenty years walnut grows to a foot in diameter, and elm to sixteen inches.”

On Garrison Road in this county lives Mr. James McClive, who has paid more attention to tree-planting than most persons in Welland. Some ten years ago he endeavoured to induce the township council to give a bonus for tree-planting, but failed. “Yet,” says he, “I planted and am still planting. I have planted over 2000 trees since.” Five years ago he planted over two miles of honey locust hedge, with a shade tree in the hedge row every sixteen feet apart; but lately he found that the trees were injuring his hedge, and in consequence was obliged to pull out about 600 beautiful trees. He has a young forest also growing of about 1000 elm and black ash. Mr. McClive affirms that by properly taking up, setting out, and rightly treating after planting 1000 healthy trees, they will live every one. This seems, he thinks, like incredible doctrine, but is nevertheless true, for he has proved it by actual practice. It will even work true in case of three months’ drought after planting. The plan of after treatment is to keep the land well cultivated and clean in a circle at least six feet from each tree.

There is nothing will advance trees or plants so rapidly and well as thus stirring the earth round them, not too deep. There is some sympathy—some mutual assistance—science has not yet precisely discovered its mode, but we know its results—between the freshly turned earth, the leaves and roots, which is above all things beneficial to growth. I have known trees cared for thus make *three times* the growth of those left to themselves.

Mr. Wm. Mussen, of near Cayuga, stated that but few trees had been planted in his neighbourhood. He was himself strongly in favour of planting. His method of planting was to dig the hole large so that the roots might have sufficient space, put in fine surface soil first, raise the tree up and down until the fine earth gets in between the small roots, tramping occasionally until the hole is full. Then mulch with fine chip manure or saw-dust six inches thick.

Mr. W. J. Kimball, of Simcoe, stated that if he were commencing on a farm again, at the age of about twenty-five, he would embellish the surroundings of his buildings with 300 hard maples. In fifteen years he could begin to tap, and with careful management they would last a life time for sugar and syrup, right at his own door-step, adding beauty and comfort to his home. If one should show signs of decay, make it into firewood—no better grows; then when cut into lumber of proper thickness it is very useful for cabinet ware. It is one of the cleanest trees that we have, not encouraging insects, etc., grows in beautiful form and gains size faster than almost any other, planted directly after the flow of sap, just at the bursting of the bud. Mr. Kimball thinks the soft maple quite inferior to the hard, both in point of usefulness and ornament. Mr. Kimball gave an instance of balsam fir, an acre of which he has known planted many years back. In forty-three years they were beginning to die, it was thought from being planted too close together. They then gave three or four saw-logs each, of one to two feet in diameter.

Another gentleman of Simcoe states that hardwood bush there, cut down forty years ago for the purpose of making charcoal, was succeeded by a growth of pine, the largest of which, trees from twelve to eighteen inches in diameter, have lately been sawn into lumber. Black walnut of twenty-five years is six feet in circumference.

The silver maple, says Mr. Wilson of Petrolea, is not a desirable trees to plant, although it looks well, as the roots run for some distance and sprout up all round. Cedar planted twenty years ago is now eight inches through.

Mr. Maccoll, Cowal, states that in that locality the white ash and elm can be easily transplanted, and will grow on any soil. Chestnut and whitewood require a sandy soil, and are admirable shade trees ; so is basswood, which will grow on any soil.

Wherever the white ash flourishes farmers will find it to their interest to set out good sized plantations, close-planted, as directed for growing timber trees. This tree is so useful for manufacturing, and is getting so scarce, that he who has ten acres of it will in a few years have a fortune, if he cares well for his trees.

Mr. King, Middlemarch, planted, in 1855, two acres of soft maple, pine, and a few hard maple. These all grew well, and now are as large as a man's body. Walnut is a fast grower here, and is, of course, very valuable. Maple, beech, ash, walnut, and elm, thrive best on clay loam ; chestnut, pine, basswood, and white ash, on a sandy soil. Mr. King says, "In planting I take pains in removing the tree from the earth, by digging sufficiently far round the roots to take it up without cutting or bruising them. If a root is damaged I cut it off with a sharp knife ; then I cut off nearly all the top, dig the hole so that the roots of the tree will go in without cramping or bending them, see that the earth is well pulverized and closely packed, then have the tree well braced to prevent the wind from moving the roots ; for if the tree is shaken the first summer it is sure death to it. In a severe drought I would water them once a week. Pine, I may remark, will grow on the hardest kinds of clay if properly attended to. It should be planted late in June."

"Over forty years ago," says Mr. Malcom, of Innerkip, tree planting was practised by a few English and Scotch gentlemen in the neighbourhood of Woodstock and Eastwood. The object was to produce groves somewhat in Old Country style. (These groves are referred to elsewhere.) As far as I have noticed, both evergreens and hardwood have made splendid growth. Among the kinds of trees that I have had experience with, two should stand at the head of the list, the sugar-maple and basswood. The maple is a grand tree aside from its noble qualities as a shade tree or fuel tree. It may yet, in the future, yield thousands of tons of sugar from this Province alone. Then the basswood with its broad leaves and beautiful form is unsurpassed by any tree in the world for honey. If we had all our highways lined with those trees it would add a wealth to the Province of which no one has ever dreamed."

"In this soil," says Mr. Shipley, of Falkirk, "a black mould of six inches with a red clay subsoil, an efficient wind-break is easily made by setting deep limbs two inches in diameter, and seven or eight feet long, of the white willow, which are easily grown." (It should be noticed that objections have been raised to the willow on account of insects which seem to choose it for a breeding place, as well as on account of its roots which spread widely, and sometimes choke under-drains.)

"I do not think," says Mr. Beckton, of Glencoe, "that there is a climate so natural to the production of wood as in Ontario. Forty-three years ago we cut in the original forests oaks over six feet on the stump, black walnut three feet, whitewood six feet, these trees being sixty to seventy feet without a limb ; ash, elm and hickory four to five feet. In planting I found pine grow very fast. A large number of low flooded flats should be, I think, replanted."

This gentleman states a point very encouraging to planters, and very true. Trees grow better here than in many other lands. But, both in planting and nurture, trees require more care here than in most parts of Europe. They have a longer summer, and

not our scorching heat or freezing cold. European foresters, or European farmers, need here to modify their practice by American experience, which generally takes time to acquire.

Mr. Rennelson, of Dumfries, says: "I have planted many hundreds of trees, usually in spring; but I have one belt of cedars which were planted on Christmas day, 1877, some maples and hickories planted on the 15th of January, and one maple planted in July while in full leaf. All are doing well. I occasionally failed of success unaccountably, yet I would characterize no varieties that I have planted as shy growers except the hemlock, few of which catch, and those which do are almost invariably destroyed by mice at some unexpected time. The watering of trees is a very laborious matter, but when properly mulched there is little necessity for watering. I prepare leaves and rotten wood from the bush for mulching. Strong manure is ruinous. Trees are often injured by twisting the bark from the stem while lifting, and also by leaving a cavity round the roots in planting. Forest trees with prudent care will do very well on a great variety of soils. Mulching I find to be an excellent regulator and modifier of heavy soils. I would, however, prefer a loam. I prefer to lift some earth with the tree, and thus leave the small roots undisturbed, but I would rather shake the earth away than leave a cavity underneath the tree."

Mr. A. D. Ferrier, of Thistledown, has been an enthusiastic and successful planter. He said, "I will briefly give you my experience in this neighbourhood. First of all, when I fixed on the site for my house in 1835, I was determined to save some of the finest forest trees as ornaments round it; so, as I was present on the spot, I got a good many fine elms, maples, beeches, etc., saved, and there they are at this day; many of them as handsome trees as you can see. Then about 1856 I planted a good many, chiefly Norway and Canadian spruce, tamaracs, balsams, maples, and elms, which grew in my garden self-sown from the old ones. I generally planted in the spring, as soon as possible after the snow was gone, and always put about a half a pail of water in the hole, and then put in the tree, and generally a mulch of short rotten straw or grass. I always took care to have the ground well fenced, and kept it clean for about three years, and lost very few trees. I once contracted for a hundred trees to be planted in grass, and fully a third died; but the rest soon filled up the blanks, and many of them are splendid trees now. Most of the hundred were Canadian spruce, balsam and tamarac, with some maples. I got our cemetery here planted in 1863, I think, with Norway spruce, white pine, balsam, fir, maples, tamaracs, and some basswoods, and they, too, did very well as may be seen at this time. The soil is good loam, not very deep, with a limestone bottom. I have some lime trees from Scotland which do very well. The borer attacks the maples and lime trees, and does much damage. The beech trees do not seem to thrive singly, and I find the hemlock very tender. The wild cherry is very pretty and hardy, and a quick growing tree. The maple frequently dies off without any apparent cause. The basswood is a beautiful tree and hardy. I do the pruning myself for the first two or three years, and find it good for the spruces and other fir trees to let the air circulate freely under the lower branches.

"In finishing planting," says Mr. Dredge, of Rockwood, "after putting the soil carefully round the roots till all are covered up, we invariably pile some stones around the roots, which keeps the ground moist, and at the same time gives solidity to the roots of the tree."

"Our soil," says Mr. T. Fraser, of Huron Township, "is principally heavy clay. We plant in the spring very early, or sometimes in the winter months when it is open weather and the planting can be done. With care there does not seem to be trouble in getting any of the trees to grow."

Mr. William Welsh, Amberley, says:—"My opinion of tree-planting is that a uniform system must be employed, according to the wants of each tract of country. For this part of the country, which is level and nearly as treeless as a prairie, I have been advocating the planting of clumps of trees on exposed places, and on the west and north sides of farms; a distance of from two to three rods in width to be laid off for the planting of trees for shelter. This width, if properly planted, I maintain, would be sufficient shelter,

that is if properly cared for and a suitable selection of trees made ; say, a hedge of cedar next the road, some of the quick-growing trees next, silver-leaved poplar, whitewood or basswood, or a mixture, then hardwood following (sugar maple being the best we have), but of course the selection might be changed according to circumstances."

Mr. R. Currie, of Wingham, says :—"I do not lose one tree in twenty. Take the trees from the outside of the bush, one to three inches in diameter, fill up with fine earth, put in a good paulful of water and move the tree from side to side so that the earth will get all round the roots. If in sod, turn the grass down and tramp the earth solid with the foot, which, if there has been too much water, will bring it to the surface, and fill up all vacant space around the roots."

Mr. G. Cowan, of Craigvale, says :—"When I was in Toronto I was noticing the men who pruned your shade trees on your streets, and considered it a shame to see such fine trees so mutilated. I always prune mine close, dress the wound, and then paint with white lead, linseed oil, and a little lamp black. This prevents the sun from checking the wound and excludes air and water."

This criticism is well deserved. The pruning and general care of trees in Toronto is very inferior. In the grounds of great institutions, trees will be seen with a succession of ugly stumps up their sides and among their branches, where branches have been cut by ignorant pruners. These of course can never heal, and stand there dumb witnesses to the quality of their caretakers.

Mr. J. Derby, of Crown Hill, says :—"Elms here are infested with caterpillars, which destroy the foliage."

Mr. James Ross, Barrie, says :—"May and early June are best for planting here ; trees from one to two inches in diameter, six to ten feet high, with the tops cut off short, succeed very well."

Mr. T. S. Macleod, of Dalston, says that trees would not grow with him on a limestone gravel, although carefully planted, mulched and watered. He finds no difficulty, however, in growing them on a moist clay-loam. He finds second growth maples (maples which had grown in a bush whence most of the larger trees had been removed) much superior to those taken from the regular bush, being stronger, more stocky, and transplanting very easily.

Messrs. Wigle & Son, Ruthven, have 183 acres of good gravelly clay-loam. They are surrounding it with a hedge and planting red cedar and spruce seven feet apart along the side of the hedge to make a wind-break.

"In my own case," says Mr. Mathew Martin, of Tilbury, East, "I encourage the young oak and hickory to grow as shade trees, preferring a tree which would be likely to produce fruit for animals and vermin, thereby saving the grain."

Mr. Marshall, of Allenford, thinks the beech an inferior tree to plant, as it does not seem to thrive when standing exposed to the blasts of winter. Hemlock here will stand the winter winds, and do well on a sandy soil. August and September, he notices, is a very trying time for newly planted trees, which should always, on this account, be mulched for two years at least.

Mr. Robert Purvis, Kinloss, says :—"Maples do well, and the evergreens, such as pine and balsam have been tried, but as they are taken from the bush in low swamp lands, they have not generally succeeded, the greater portion seeming to die. The white ash, for the purpose of planting, is a very valuable tree, makes an everlasting plantation if care be taken of the young sprouts ; grows very rapidly here, and makes excellent timber for a great many purposes. It is becoming scarce, too, in our forests."

Mr. J. P. Macintyre, of Tiverton, stated that quite a number of the elms planted there have failed. He finds that in transplanting them from the forest, elm trees require a great deal of care so as not to injure the tap-root, for if that be injured they do not thrive.

A farmer near Durham stated that he would plant some acres of European larch if he could get them cheaply, but the general nurseryman charges so much that it discourages planting.

The numerous descriptions and statements under the present heading will give the reader, perhaps, a better idea of the state of forestry in our province than any other method. Throughout older Ontario we have cleared the woodland. Portions, larger or smaller, yet, indeed, remain on almost every farm; but too often they are over-run by grass and pastured by cattle—processes entailing forestal death—in the present to the beneficial influence of the forests on the adjoining fields, in the future to the forest itself. (Forest ground, in its natural state, covered with undergrowth, is a deep and extremely porous bed, which holds for a length of time vast quantities of water. But, uncared for, open to cattle, sun and air, the solidified and grass-covered earth no longer forms this valuable reservoir). In some places more care is taken, but these are the minority. What tree planting has been done throughout the province consists chiefly of lines of trees, generally of maple, here and there along the road-side, or as protection to a few out of many orchards and farm-steadings. For this purpose they are valuable, though ever-greens would be infinitely better.

Let us say a word here in favour of planting the Canadian pine. Planted as wind-breaks, wherever I have found it, it has been effective and thriving, and after thirty years, showing no gaps. In groves it does better than maple, though that does well. Those who care for trees near residences might well choose the pine, for of all trees it is the one most conducive to health—its resinous exhalations purify the air; there is beneath the sun no such atmosphere as that of the pine forest. It is, too, for those who love the beautiful, and pass through life rather observing the flowers than the thorns, pleasant to see on nights when all around is frost and snow, the bright light from door and window, against the sheltering wall of adjacent branches, illuminating, with beautiful gleams and shadows, a thousand ever changing hollows and waves of dark pine foliage, till it fades away in glimmering dulness towards the distant road.

To remedy the present state of affairs, it is most urgent that simultaneous efforts be made in three directions. First, to plant wind-breaks, evergreen where possible. Next, to care for, enclose, and preserve what portions of forest we can yet retain upon our farms, where they are not already too advanced in decay. Few who own these stores of timber are aware how valuable they will be in the near future. Next, to commence plantations, of which, in Ontario, there are as yet extremely few. It is in the power of every farmer now, at slight expense, to plant a five-acre patch of white oak, walnut, ash, or hickory, which will, ere long, be as valuable as five times as much cleared land. And to encourage those who choose to adopt this course, it cannot be too often repeated that they need not limit the possible by visible growth. Carefully planted, judiciously pruned, and frequently and lightly cultivated, trees will grow three times as fast, and look three times as well as those specimens, planted in haste and left to live or die, we view standing in uncared-for loneliness, here and there along the roadside path.

Years ago we suffered the inconveniences of living in a country full of trees. To remedy this, we went to work with such vigor that we should have soon been suffering those of living in a country destitute of trees. But there is yet time. The trees we still have will give a breathing space, if cared for, till those we plant can grow; and if Ontario move but half as energetically in the matter as some of the States are doing we shall leave many a broad plantation to those who follow us.

Mr. Henry Doupe, Kirkton, mentions that about fourteen years ago, in the month of October, he planted a score of spruce and balsam near his house ; all grew and did well and are now about twenty-four feet high. The plants were brought from Egremont, a distance of sixty miles. Spruce and balsam planted along the road side would look well, he remarks, both in summer and winter, no cattle grazing on the roadside would meddle with them ; soil, a deep arable clay.

Mr. V. E. Buch, Ottawa, says "I have myself raised numbers of trees from seeds and nuts. Had I a few acres instead of only a few city lots, I should certainly have started a forest of my own. That trees will live and thrive with little attention is, from the experiments I have made, a patent fact—and you may be sure that there is no trick in reclothing this country with wood artificially within a very few years if it was thought desirable to do so. I have butter-nuts ten years from the seed that are thirty-four feet high, and two feet three inches round, one and a-half feet from the ground. The branches of one tree spreads thirty-three feet, and it began to bear nuts at seven years old ; this tree is grown in grass and was not pruned with a view of making timber. The butter-nut is the most rapid growing tree we have hard for a wood tree. I have the *acer nagundo*, box elder, ashleaf maple, or Manitoba maple—it goes by all these names—eight feet high ; it is not yet two years old, whilst my two year old black-walnuts are only three feet high and the horse chesnut seven years from the seed, is twelve feet high. Its sap is suitable for sugar. During the first year's growth of these seedlings every leaf and twig was allowed to remain, but the second spring all side shoots were trimmed off and the trees ran up in straight rods ; this is evidently a most desirable tree for clothing our western prairies, as it is a native of the soil ; but whether it is as desirable as many other sorts, I have personally no means of knowing ; it seeds most profusely, and there is certainly no trouble in getting them to germinate. For my own part I look upon the difficulties of reclothing our forests with life as so many myths for idlers. Every one who has made any effort to reproduce timber has been well pleased with the success which has attended the effort made ; any lover of nature must receive ample compensation for all his trouble, and those who plant for a money reward will be well repaid for all the labour bestowed on them. I should have stated that I have black walnuts two years old, three feet high, and ten inches round ; it is a comparatively slow-growing tree. Some of the poplars and willows grow much faster than these, but are raised from cuttings. Where wood is required speedily, as it is in the North-west, poplars and willows should be set in alternate rows, and alternate trees, with hard wood varieties, if required for home fuel use ; if for sale, they should all be grown, every species by itself, in nursery rows."

Mr. Ballantyne, of Ottawa, gave some experience in planting on a sandy loam with a clay subsoil, natural drainage not very good. Saplings taken from the forest, swamp maples seven feet high, nine years planted, now thirty feet, and six inches through. Poplars, several varieties, grew very fast, and will make a wind-break in far less time than the maple, particularly the Balm of Gilead poplar. They are, however, easily broken by the wind, and are apt to get foul with suckers. Flowering maple, sowed in 1875, transplanted in the spring of 1876 when about four or five inches high ; some of them are now nearly thirty feet high. Next to the poplar the red cherry is the fastest growing tree I have tried. Pines planted three feet high, in six years are twenty feet in height and six inches in diameter, Swamp elm seven feet high, planted in the fall, is in six years sixteen feet high ; although making such slow growth this is quite thrifty. White cedars grow well but slowly. Balsam, spruce, hemlock, and white spruce, all grow well. I have rarely lost a tree in planting. In setting out the trees one of the main points is to bring the earth and roots into close contact.

Mr. Checkly, North Augusta, states that "several attempts have been made to replace sugar bushes, but in nearly every instance the attempts have proved failures, owing, I feel satisfied, to lack of proper care in tree planting, and proper care on removing the trees from their natural places of growth. I have planted a great many trees myself, and have found from my little experience of about eighteen years that hard maples taken from sandy soil do not do well on clay or rock land, and that those I took from the same quality of soil as that where I set them grew well ; but soft maples have succeeded much better on our home clay and sandy loam than the hard maples. I have transplanted

besides the maples, water elms, pine, white and black spruce, birch, hickory, basswood, and cedar. I have known better success with elm and basswood than with any of the others. Directly opposite my place there is a row of hard maples that have been planted about twenty-one years, and among them is an elm larger than any of the maples, although planted the same time and growing vigorously, while the maples are beginning to decay, and some of them may be removed at once. Fourteen years ago I planted twenty-four maple trees and a number of spruce. I took every precaution in removing the maples to carry away as much earth with the roots as I possibly could, and selected the trees nearest the clearing because they were better furnished than those growing thick farther away; I marked the north side and set it to the north again, and to-day I have but one maple alive, and it is a soft maple. The soil I planted in is clay loam. There is another great drawback in planting, and to insure success must be attended to, and that is mulching; the ground must be kept moist, to secure a growth. Nature has supplied mulching for the forests in the falling of the leaves, and I have always found that sugar bushes used as a pasture invariably die out, while those that are not pastured and allowed to grow up to underbrush thrive the best and are not affected by drought. With regard to the clearing up of the country, affecting the rainfall and drying up streams, it is doing both. I remember distinctly, where the mowers and reapers are now used, seeing water stand all summer when the land was in a state of nature, and the stream that runs through the village where I live shows signs of the supply being cut off, which it received in former years from the great swamps along its course that are now cleared up and under crop. I am sorry that more has not been attempted before now in the way of tree-planting, as our noble forests are fast becoming things of the past, and owing to the country becoming so cleared up, the wind and drought together will be great drawbacks to success in tree planting."

Mr. Checkly's remarks concerning sugar bushes dying out where cattle run are worthy of careful notice. A *portion only* of each wood-lot should be left for cattle. The twenty-three maples which died must, I think, have been ill-drained. The soft maple lived; wet land would not injure it so much.

Mr. G. D. Platt, Picton, remarks that in some instances maple orchards have been planted in that locality, and thrive well.

Mr. W. Windatt, Darlington, observes that "about the second or third year after planting trees, if there come a very hot spell in July or August, the leaves become scorched and the trees die. This happens most frequently in hard clay. Perhaps more care in planting or mulching might obviate this. I am aware that sufficient pains have not been taken in planting, the general practice being to dig a hole big enough to take the roots, plant the tree, put in the earth and give no further care to the matter."

Mr. James Keays, Russell, remarks that in his experience, the silver maple is one of the most rapid growers, and if pruned well the trunk grows large and high.

Mr. R. Osborne, Newcastle, observes that hundreds of trees are planted every year, of which not much more than twenty-five per cent. grow, but if properly mulched and staked the first year, nearly all would grow.

Mr. W. C. Switzer, Emily, states that his opinion of planting is, for maples, take them from soil as much as possible like the soil you are going to plant them in. As soon as the weather gets warm in the spring after planting, put some long manure or wet straw round them with a few stones on the top, and there is no mistake about growth.

Mr. William Harrison, Mackville, remarks that over twenty years ago he planted a belt of evergreens as a wind-break for his orchard, of pine, spruce, balsam and hemlock. This has answered well, and he has every reason to be satisfied with its thrifty appearance.

Mr. W. Ditchburn, Rosseau, remarks that in that locality maple, beech, and red oak require a deep soil. Soft maple, basswood, or lime, black ash, black and white birch, spruce and white oak, thrive best on flat and wet lands.

Mr. Henry Westney, Highland Creek, planted in the spring of 1883, twenty-five thousand young forest trees, choosing for that purpose ash, elm, pine, fir and spruce. He finds but a small per centage of loss on any of these kinds excepting in the firs, of which

but two hundred grew out of one thousand planted. The wet season of 1883 was, it may be remarked, very favourable to the success of newly planted trees.

Mr. John Gibson, Markham, says: We have a number of trees, which, with careful planting, grow easily and very rapidly. Of these the European larch is about the foremost, though the tamarac, maple, ash, cedar and Canadian pine, with a fair mixture of poplar, in a very few years give good protection and a profitable crop. As to the time of planting, I have found about the first of June to be quite early enough.

Mr. B. Gott, Arkona, a part of the country rejoicing in a rich sandy loam, excellent for growing trees, especially seedlings, has carried out some very valuable forestry experiments. Here is a half-mile wind-break of the Scottish larch, now twenty to twenty-five feet high, and ten or twelve in spread of widest branches. These larches grow, as all trees seem to do in this soil, with remarkable life, and the line of foliage—a foliage composed of multitudes of long filamental festoons of refreshing green—swaying responsive to the afternoon breeze, forms a picture to be remembered. These have been twelve years planted, using plants of two years' growth. These were planted as early in spring as the frost would permit, as the larch is among the earliest trees to start into foliage. On high, dry soils, where there is no danger of heaving from frost, fall is preferable. It is well to sow the seeds early in spring, transplant the next spring, cultivate two years, then plant permanently six feet apart.

Near by is a block of young trees, on the one side the dark Austrian, on the other the more light and azure-tinted Scottish pine. These have been planted eight years, with two years' seedlings and treatment similar to that of the larch. Mr. Gott considers that the best wind-break of these would be in double rows interspersed Austrian and Scottish, ten feet from tree to tree, and the rows six feet apart. This is at right angles with the larch wind-break previously mentioned, and such is the influence of these wind-breaks on that large part of the grounds controlled by their shelter, that it seems in winter a different climate from the rest. There is a total absence of cutting winds, and work is possible and is performed, which would, in the unsheltered parts, be out of the question. When we consider with how little labour and in what a comparatively short time these excellent wind-breaks have been grown, how valuable the purposes they serve, how beautiful their appearance, and how greatly in both respects they would enhance the value of any farm on which the example here noted was initiated, it is a matter of regret to observe that many of the farms around, which had some time been spared in the matter a dozen years ago, might now have been well protected by beautiful wind-breaks of the same class, are yet undefended from the wind and cold, and, as the small remains of forest near them are cleared, will become more and more exposed to their assaults.

Here are also some fine specimens of Canadian white pine, forty feet high and twenty wide, close grown, thriving, and not having, indeed, a weak branch on them. These, when seedlings three feet high, were taken up from the forest and planted in blocks of three in a block, in the latter part of May. Mr. Gott remarks that he prefers to plant, on dry soil, a little deeper than the seedlings stood in the forest, say a foot deep. But it will by no means answer to dig only the depth you wish to plant the tree, as that would leave the trees standing on the hard subsoil—that also must be carefully dug, and the tree then put in, with care. By the way, always put in some of the best surface soil around the roots, and to work it in by hand, if time allow. "And if Time did not allow," remarked Mr. Gott, "I would do it in spite of him."

This subsoil digging, it must be remembered, would not answer in tenacious clay, unless a large area were so dug. To do it at each tree site would often be to create water holes. On the other hand, so that the water can get away, nothing can be better. But in deep sandy loam it is safe; that has a natural drainage.

Near here, on the same soil, is an instance of the ill effects—in fact, of the waste of time and money—of less careful planting. Two hundred trees were bought eight years since, and planted hurriedly in half a day, the precautions mentioned above, of course, not being taken. The result was, as might have been expected, very unsatisfactory. Here

have been large losses of trees yearly, which had yearly to be replanted, while those which remained have never made a healthy growth. Ten dollars' worth of time in planting, would have added five hundred dollars' worth to the value of the farm to-day.

Here are also some fine cedars in hedges, twelve feet high, planted eight years, six inches apart, three feet six inches high—planted late in May. Set closely, thus, these are excellent in hedges—in fact, are among the best hedge-trees we have. (Cedar loves a moist soil; but a spreading cedar wind-break, by its close shading habit, covers the ground, retains the rain in the ground, condenses moisture in fogs, retains it and does much to make the soil it covers a fitting soil for itself.)

Mr. Gott remarks that, instead of mulching, he cultivates, and thus keeps the ground clean from weeds and mellow with working, near his trees. This is, of course, the best calculated to aid the tree in rapid growth. The other, mulching, is only the next best. He also states that many have failed in transplanting evergreens by want of thought. "They take them," he says, "from a deep sand where their roots may be four feet long, take what sized root will come and plant it in a clay loam. The demand for sudden change of habit is more than the tree can comply with."

Mr. Saunders, F.R.C.S., of London, has a remarkably efficient wind-break, planted by himself fourteen years ago. It is of great length and consists, first, of a hedge close to the road, of the Osage orange and barberry. Six feet inside of this is a row of silver maples, six feet inside again a row of Scottish and Austrian pine, and six feet again inside a row of Norway spruce. The trees stand ten feet apart in the rows. The soil is clay loam. The planting was done in May with nursery seedlings eighteen inches high. The trees are so planted as to break the openings. No wind-break is more beautiful than one so arranged. In summer the dark and light greens of the evergreen and deciduous trees afford an agreeable contrast, while in the fall the heavy masses of the pine trees are brilliantly outlined on the wall of crimson foliage behind.

Not far off, in another quarter of the city, Mr. Saunders has hundreds of fine young trees in excellent growth. Here is particularly to be noticed the Norway maple, planted only eight years, yet twenty feet in height and twenty in spread of branches. This tree is admirably adapted for shade or for a wind-break, from its peculiar habit of branching. Its branches are thickly set, and all full leaved on the inner as well as on the outer portions of the tree. Its lower branches grow close to the ground, a shape purposely procured as, of course, no wind-break where the air rushes through below is at all so efficient. The shape is obtained by planting one year seedlings in nursery rows for two years, and then transplanting them again to their ultimate positions. A large, closely fibred, root is thus obtained, easily transplanted, and able to nourish whatever head may be on the stem without cutting back. Forest saplings, on the contrary, which are generally taken from six to ten feet in height, send out branches high above the ground, and do not, of course, make nearly so efficient a wind-break. Here are also some magnificent specimens of the cut-leaved birch, eight years old, tall and graceful, its deeply serrated foliage resembling draperies of admirably designed lace, while the evening breeze, perpetually changing the arrangement, still presents new and fanciful arabesques to the view. Near here in the asylum ground is a double line of American elm, planted but thirteen years, yet fully forty feet high. The road passes between. It is a fine avenue, and had double the space been allowed between the lines of trees would, in time, have been a noble one. The planters were not apparently aware with what liberality nature would have assisted their work.

WIND-BREAKS AND SHELTER-BELTS.

In the application of forestry to farm purposes, this branch is one of the most important, especially in Ontario where, in many parts, we have carried to so unwise an extent the clearing of the land. In many districts which I remember heavily clothed with forest—in many more where I can recollect the forest cleared as far as it should have been cleared, that is to say, 30 per cent was yet woodland—there exists now both in one case

and the other, vast extensions of cultivated land, broken here and there by a straggling patch of decaying forest, abandoned to the tender mercies of the cattle—here and there by a mile or so of young trees along the road. But the forest is virtually no more, all is swept by the bleakness of the winter storm ; all is dried and scorched by the summer wind and the summer sun. It is in such districts that the planting of wind-breaks would be found peculiarly valuable. Much evidence, in fact, with regard to their value, will be found from correspondents on other pages. It is but ten or twelve years and a little labour, and your now exposed and wind-swept farm may be surrounded by imperious walls of beautiful and living green. For this purpose, for instance, the cedar will thrive on many soils. It is true, it is naturally a native of the lower and moister localities,

“From the hollow oak loud hoots the owl,
From the cedar swamp the gaunt wolves howl.”

But here is the peculiar strength of forestry—that it possesses often the power of, ~~not~~ bringing its soil with it, but of improving a soil for itself. If you look at this tree in the forest, you will find it flourishing best on moist, sheltered deep soils, often, but by no means always, rich. But you will see at a glance one main characteristic, it loves to shield its stem. Even in the dense bush its branches lean downwards towards the ground, sometimes they nearly touch it. But we plant, when young, our rows of little cedars ; their branches soon shade stem and ground around ; they grow up in the field habit, *i. e.*, they shield themselves by bushy branches far more than in the woods, and with care in a few years we have a dark, dense wall, a long, extended cone, its height fifteen feet, its breadth on the ground perhaps twelve, and to be twenty. The lower branches will be close to the ground, all below will be always dense shade—spring, summer and winter, the mass of leaves are there. The rain-water falling through the tree, the dew which its leaves distil,—for all trees are alembics to distil as well as evaporators to throw off—all falls below, where neither sun nor wind can get to dry it. The ground will be always shaded and damp, and thus the cedar will have made the soil it loves best from the soil it loves less.

Then there are the spruces—Norway and Canadian—nothing can make a more beautiful wind-break than their long lines of mingled dark, light, or bright bluish green. They stand trimming well ; you can slope the face as you choose ; but remember that these are not hedge plants ; do not trim them too closely ; it is a wall of trees you want. I have known trees of this class clipped to hedge size, and for a few years make a pretty hedge, then turn brown and die.

Then there is the pine—Austrian if you like, or Scottish ; either will form a solid wind-break, but I prefer the appearance of the Canadian pine. When we look at the grim, heavy branches of the Austrian, one is at no loss to think why its home was called the Black Forest, the known haunt of many a robber chief, the reported one of many an evil spirit. One can well fancy the terrible Wehr-wolf emerging to slaughter, from its dark, cavernous shades, or its dark branches overhanging the water-side and shading the whirlpool where the treacherous fiend of the Lurlei successively fascinated, and success

ively slew. Its Scottish namesake, too, is of wierd and gloomy appearance. One may imagine it well as forming the old Glenfinlas shades,

“Where walks, they say, the shrieking ghost.”

Our Canadian pine, though of hue more sombre than either, yet bears, to my mind, forest verdure of more pleasing form. Its straight branches stand firmly like its trunk ; but the massing whorls of its long needle foliage wave freely in the wind on their flexible stems. Underneath is always carpeted with clean red-brown needles ; always around it seems to me a healthy air. We have this, too, in Ontario, in wind-breaks forty years of age, and know it a success.

Then there is the Scottish larch, which, described elsewhere, makes a wind-break of rich light-green and fanciful lanceolated foliage. It is the link between the deciduous and the evergreen ; its leaves indeed fall, but stay long and return shortly.

Owing to the difficulty of transplanting evergreens—a difficulty which, as explained elsewhere, is, if care be taken, much more apparent than real, we seem likely, throughout Ontario, to have many more deciduous than evergreen wind-breaks, the maple being largely used. The chief objection is that in winter, when it is most needed, the deciduous wind-break is least effective. On the other hand, these hard woods give excellent shade, and in the case of the maple will yield sugar ; in that of the elm, perhaps the best and toughest second-growth wood that can be used on the farm. But with maples and such trees, they should be planted small, and growth of buds near the ground encouraged—the top may, if chosen, be slightly cut back to assist this. With evergreen, larch, spruce, balsam and pine, you are tolerably sure to get a low growth, with the others not so sure ; if not cared for they are apt to have clear stems eight to ten feet high, a great loss in wind-breaks, which should be, as far as they may, impervious. For this purpose such trees as the Norway maple are excellent ; its thick, dense, low habit of growth gives perhaps the best deciduous wind-break. If we want one effective in a short time, there is nothing so quick of growth as poplars, silver or Lombardy. But we must remember their habit of throwing out suckers. From some following correspondence, it will be seen that, wherever wind-breaks are planted throughout Ontario, they have proved very beneficial to the crops. One or two writers remark that though very valuable to the field generally, they have proved injurious to the crops close under the shadow. This will be most likely to be the case on the north side of such a strip, and, where this is feared if, instead of grain, a narrow strip of grass be cultivated there, I have found it pay as well as the rest of the land.

As will be found from instances elsewhere, the farmer who has protected his property with these wind-breaks has changed the climate of his farm. It will no longer be wind-swept, the grass will grow earlier and remain later, the cattle will not need such lengthened housing, nor will the drying winds of summer so soon take the moisture from the ground. It adds, too, not only greatly to the value, but greatly to the beauty of the farm. Frequently, in passing through the country, on seeing few and far between, a beautiful wind-break of this class, the pleasure of beholding it is mingled with regrets that the time has been allowed to pass—that the dozen or fifteen years that it took to create this admir-

able production had not been employed by the owners of numerous farms in the vicinity in procuring as efficient and as beautiful protection for their own.

The following statements give the effect of wind-breaks where they have been established throughout Ontario. They are from the Township Clerks of the various localities, gentlemen who are well informed of the progress of the adjacent country.

Dawn.—When fall wheat is protected by the woods around, the frost does not seem to hurt it nearly so much as when out in an open field. Both fruit and crops thrive better where thus protected.

Esquesing.—I have myself observed the beneficial effects of planting trees closely for shelter as a protection to fruit and grain crops.

Burford.—Wind-breaks are very beneficial, but when grown take about all the substance from the soil from two rods on each side. Nevertheless, they are grand for sheltering fall wheat and clover.

Blandford.—Have observed great benefit from such shelter. Have seen fine crops of fall wheat and clover sheltered by belts of timber from the west and north winds, while in more exposed situations such crops were comparative failures; also consider such shelter of great benefit to orchards; the trees seem to thrive better when so sheltered, and the more tender varieties can often be successfully grown.

Mersea.—Where fields and orchards are sheltered, especially from the east winds, the effect is very marked. Where—as here—the snow-fall is light and generally of slight duration, fields protected by the forests produce much the best crops of wheat, and the orchard derives a like benefit.

East Flamboro'.—The effects of trees planted for wind-break, or shelters for fields, especially west winds in spring, so far as I have observed, have proved beneficial to crops in general.

North Easthope.—The experiment of wind-breaks here has been good, especially in the matter of orchards.

Minto.—Fruit, grass and crops thrive the better for wind-breaks.

Dorchester.—Have observed for a number of years that fruit and fall wheat do better where they are sheltered by trees.

Moore.—The benefits resulting from belts or wind-breaks may be seen any season, almost, in the improved condition of winter wheat, compared with fields in exposed situations where the cold, biting winds have unrestrained sweep. Fruit trees also thrive and bear better, grass starts sooner in the spring, and stock have shelter in cold weather and shade from a scorching summer sun.

Dummer.—A natural growth of cedar, pine, elm, etc., has grown up along some of the fences close enough for a wind-break. Fall wheat and fruit trees are decidedly benefited by such shelter. I cannot say with regard to spring crops.

Egremont.—Had a field of wheat this summer in which a few maples were saved when cleared; these have grown bushy and very beautiful. I noticed that the wheat was heavier and plumper around these trees than anywhere else in the fields.

Glanford.—Where wind-breaks have been grown the orchards and crops sheltered by them have been greatly benefited.

Grosfield.—Last year wherever wheat was sheltered from the west winds it was good; where not sheltered it was all destroyed.

Crowland.—There is no manner of doubt that wind breaks are of decided advantage, inasmuch as it prevents the fields from being denuded of the snow, which serves as a covering for all that may be committed to Mother Earth, the good effects of which I have demonstration of every year.

Oxford.—Wheat, and all fall plantings, peach and other trees, are very much benefited thereby. Such wind-breaks are becoming more in use yearly.

Tilbury East.—Planting here is only in its infancy, but it is observed that the fields farthest from the bush fare badly in the winter and spring under fall wheat. Indeed it is very questionable if fall wheat could be raised profitably in this section now the whole country is denuded of forest or threatened to be.

Rochester.—No wind-breaks planted, but bush on the north and west of growing crop has a markedly good effect.

Euphrasia.—Wind-breaks eventually become both ornamental and useful; grass and crops do not so much require wind-breaks as fruit does. In many fruit-growing sections, the apples especially are blown off by wind before fully matured for want of proper wind-breaks; this I look upon as a great evil, as Ontario can raise fruits well, and there will be a great demand in the North-West as well as in England.

Harvey.—Where the crops are sheltered by the forests it preserves them by keeping the snow on later in the spring. Out in the clearnce the wind drives all the snow off, leaving them bare, only around the fences, and common sense will show the necessity of wind-breaks and shelter even for the cattle as well as orchards and grain crops.

Stamford.—Wind-breaks are always beneficial, particularly to the apple crop. Close to trees that are growing in the live fences, however, grass and crops do not thrive.

Canonto.—The effect of some wind-breaks planted here can be seen by the merest tyro, so much so that people are beginning either to plant or leave saplings as they clear their land.

Colchester.—Where the natural forest has protected farms on the west and north I have always noticed that the crops have always looked and been better than others in the same locality not so protected.

North Gwillimbury.—A precisely similar statement.

South Gwillimbury.—Have observed, and heard also from those owning wind-breaks, that they are a wonderful help to growing crops as well as orchards.

Canboro'.—Have one field sheltered on three sides by bush. On that field I am sure of a crop of fall wheat, while on land not sheltered by trees the crop is sure to be heaved by frost as the snow blows off, and nothing is left to protect it.

Osprey.—Have an established wind-break round my orchard, and the effect is that the trees are sheltered from the severe winds in winter and spring, and that the apples are not so liable to be shaken from the trees in fall; but the break is of poplar, which must soon be cut down as they have completely filled the orchard with a network of roots and young shoots. (As repeatedly stated elsewhere, the poplar is a very valuable tree for many reasons; but great care must be taken to put it only where its propensity to throw out suckers will do no harm.)

N. Cayuga.—Know one or two wind-breaks that have grown up naturally, and have observed that the fields were sheltered thereby to a distance of twenty rods and upwards, and both grain and grass, where so sheltered, have thriven better. Have not had an opportunity of observing the effect upon fruit.

Willoughby.—Few have planted wind-breaks, but where they have I have no doubt that the result is better, especially on fall wheat, clover, and fruit of all kinds.

Laurel.—Know one grove along the north side of a lot, and near this grove the vegetation is much more rapid in the spring, and much more early. Also, the crops attain there a much greater growth. The most useful trees for this purpose are the balsam, spruce, pine, cedar and hemlock. I have one of balsam, spruce and tamarac around the north and west sides of my orchard, which have been planted about twenty years; and these break the wind so that the storms in the autumn do not shake the fruit from my trees as from those of my neighbours.

Bruce.—No wind-breaks planted out that I am aware of, but wherever the crops are sheltered by what remains of the original forest, the prevailing opinion is that they thrive better. This refers more particularly to winter wheat.

Down.—Many farmers have planted trees, especially along the western side of their farms, and the change has been very noticeable in the sheltering and protection of fall wheat.

Amabel.—It is well known to every farmer here that land sheltered in the winter season is more favourable and surer for fall wheat than unsheltered.

Eramosa.—There are several who have established wind-breaks; though the trees are not planted very closely, and in every instance under my observation the effect is beneficial, to grain crops especially, in sheltering from parching winds, and encouraging more

heavy dews. (This is a point not to be lost sight of. If you pass by a row of pines in a heavy mist, you will find it almost raining under the pines, almost dry elsewhere.)

Caradoc.—A few have planted pine, and a good number have planted willow for this purpose. The past winter, to a greater extent than formerly, proved the utility of forests in shielding crops, as the wheat in sheltered situations invariably proved superior.

Adolphustown.—Where protected by wind-breaks, fruit, grass, and crops in general most assuredly thrive better.

Colchester.—There are no persons in this locality who have planted trees for wind-breaks, but many have left strips or belts of timber along the west boundaries of their farms; and wherever this has been done it has proved a great benefit, especially for fall wheat. In the instances where timber has been so preserved the owners would not have it destroyed on any account, which is a good evidence that it is of advantage.

Oneida.—There is a large growth of poplar trees growing on the line between myself and my neighbours on the west side, and I can now raise good wheat on an exposed knoll where I could raise very little before.

NEW FOREST PLANTATIONS.

We can point to very few plantations of trees in Canada of such age as to be useful for examples. A few will be found under this heading, obtained in various parts of the United States. It will be seen by observation of these examples, and, in fact, by reference to nature itself, that in starting a plantation of trees, in most instances it is well to mix the trees. Then there is a point in drainage to be considered. If we can, with a subsoil plough or otherwise, deeply cultivate the whole area of ground, it is all the better, and better still if done the year before. But if we are digging for each tree separately, we may dig in a light or leachy soil as deeply as we choose; not so in stiff clay, the water may lodge under the roots (unless, indeed, it be underdrained). The next thing to be considered is, that if we plant our young trees so as to shade a great deal of the ground and to shade one another's stems, they will grow all the faster. With this object it is well always to plant many more trees than we intend ultimately to remain there. Now, if we can mulch all the ground for our plantation, we can plant our trees as thickly as we like; but if we intend to assist our trees by cultivating the ground around them (it may be done with a crop, and often is so done), we must leave room for our cultivator between the rows. An artificial forest, planted and grown for the production of tall, straight clear timber, is a very different thing from our natural woods. In it the trees are planted as closely as experience teaches they will stand and thrive, giving each tree sufficient room for its branching top to extend, and no more. Such a forest does not need, as does the natural forest, the protection of undergrowth below to shade its soil, its roots and trunks. Its own close-set formation gives shade in every part. The outside trees will branch to the ground—the inside not.

In all efforts at tree culture, it should be remembered that, though we look to nature as our original guide, yet experience teaches that, with our assistance, productions may be secured infinitely more valuable than we would otherwise have obtained. The wheat plant exists in nature, but not the wheat field. It is so with trees. If we plant them and no more, they may grow or may not. But if we care for them, they can not only be made to grow far more rapidly, but they will grow in the peculiar manner, and yield the particular kind and class of timber we intend, just as certainly as the grafted orchard will bear the grafted fruit. Suppose, for instance, that we desire a closely set forest to grow

us long, straight trees, fit to yield clear beams of either hard or soft wood, we must plant the trees at proper distances, thin them at proper times (the eye can easily tell when), always remembering the principle of keeping the ground well shaded, and keep the surface ground stirred and cultivated, taking care not to hurt the roots, which roots we will find will almost seem to be watching us and to know what we are about. If we give them the habit of having the ground lightly cultivated, we will find some inches of earth always left for that purpose; (and there is nothing that more benefits a tree.) Trees, too, bring their own manure; they draw much nourishment from the atmosphere and from the rain; they drop it to their roots in falling leaves, which should neither be carried away nor blown away. But in speaking of a plantation where we can cultivate, cultivation will mix the leaves with the mould, and it will answer far better than the natural plan. Nature does not need a tree as soon nor as free from knots as we do. The next thing to consider is how to avoid growing these knots, and so we come to pruning. The rule of the best foresters in attempting to grow first-class timber is that "the whole surface of the ground should be canopied over with the heads. This canopy should, by gradual and annual pruning, be raised to the greatest possible height, and by gradual and annual thinning be supported by the fewest possible stems. For pruning trees to grow to their greatest possible height, the rules are simple, and they are applicable alike to the nursery-plant and to the largest timber-tree: Keep a clear leader. Cut off all branches large enough to compete with the stem, or which grow parallel to it. Shrive the stem up one-third of its height. Cut all close to the stem. With the above exceptions a tree cannot have too many branches, as the returning sap of each contributes to the growth in girthing of all that part of the stem which is below it, and to the growth of the root both in length and girthing. But pruning, like thinning a plantation, cannot be too gradual. It should be annual."

I would wish to press on all owners of farm property in Ontario, especially those whose woodlots are cleared, or seem decayed past renovating, the great desirability of establishing a plantation of trees along the north or whichever be the most exposed side of their farms; call it, if we will, a shelter-belt, but when once about it, it would be much more advantageous to make the shelter-belt broad enough for a small forest. When we consider that such a shelter has often been known to double the crops in the adjacent fields, remembering too, the value of the wood which may be produced there, and how greatly care and cultivation may accelerate the production, it is not too much to say that, in the rapidly approaching scarcity of timber throughout Ontario, five or ten acres so devoted might become more valuable than the rest of the farm.

On the following pages will be found, first, directions in planting by practical cultivation, and many valuable instances of actual experiments.

The following letter from B. Gott, Esq., Arkona, a very successful cultivator of forest trees, will be found to give many points of great interest and value to all who desire to plant:

TO R. W. PHIPPS, ESQ., ONTARIO.

My Dear Sir,—With much real pleasure I attempt to answer your late enquiries addressed to me, regarding some points in Canadian forestry in Ontario. In doing so I

beg most respectfully to say that I am intensely and increasingly interested in the subject, as a great national question fraught with future and lasting results and possibilities. It is impossible to conceive of a better or more valuable, and it should be, enduring heritage than has been conferred upon us, the people of Ontario, in the matter of our native forests. I am perfectly astonished and almost overwhelmed with the force of the reflection when I attempt to conceive the length of time required in the preparation of the soil, and then the all-pervading energy required for the production and perfection of the various crops of beautiful, varied and useful trees thickly planted over our landscape long before we saw it. Who shall deny the superintendence of an *All wise Providence* who "*sees the end from the beginning*," when he contemplates this piece of wonderful forethought for the best interests of man? I view with much and deep regret the depletion and destruction of the wealth of forest timber in Ontario. In considering the small and ineffectual efforts made for the conservation and reproduction of our trees, I am solicitous for the future of this country. If we succeed in destroying our present growth that cannot be reproduced, what, I ask in all earnestness and candour, will become of us as an agricultural people? Most certainly something can and must be done in some way to slacken our reckless destruction, and in some measure to provide for the future by timely planting such valuable timber trees as are known to succeed well amongst us. I therefore congratulate our government on their movement in forestry matters, and am hopeful in the work they have already so energetically set on foot.

I am sorry to have to state in the outset, that in the matter of planting forest trees and rearing them up to their various degrees of beautiful development, my personal experience is not by any means large or even exemplary. Though I have planted and cared for many hundreds, and I may say many thousands of trees in this country, and seen them make a nice and satisfactory start, yet when we consider these feeble efforts and put them beside the amazing plantings of a Douglass of Illinois and many other western experts, our efforts fade away to utter nothingness. This kind of forestry planting and culture we from our own efforts as yet know nothing about, but I feel that the time is fast approaching when we shall be compelled from necessity to familiarize ourselves with some of the introductory facts in the case, and I am glad, Sir, of your introductory labours and enquiries in this direction. But I must hasten to the question in hand.

OUR SOIL

is a mixed clay and sandy loam, rather porous and somewhat rolling, and naturally well drained. It was originally densely covered by a heavy and well matured growth of forest trees indigenous to such soils, and is rich in all the varied elements of vegetable life, manifested by a luxuriance truly charming. After clearing off the first crop of trees, as far as I am aware, and with great labour and difficulty relieving the soil from their everywhere prevailing roots and stumps, I have grown upon it almost every species of fruit and forest trees in our every day acquaintance. I have now a block (as the nursery-men would say) of mixed maples, etc., planted with forest seedlings, twelve to eighteen inches in height four years ago; that are as handsome in their growth and prosperity as a picture. They are about eight feet high, well branched and as clean and pretty in their stems as could well be desired, and now ready for planting wherever they are ultimately destined to remain.

I have also planted, with equally good results, white ash, basswood, ironwood, white wood, beech, elms, hickory, oaks, chestnuts, etc. The basswood and white ash are the most surprising growers, and soon establish themselves in the soil and make stout and aspiring trees that give delight to the cultivator. I have given much attention to the growth and propagation of the nut bearing trees native to this country, as the

BLACK AND WHITE WALNUT,

the hickory and the chestnut. But of these the interest clustering around the two walnuts seem to be generally greatest, and I know several instances where they have been planted in considerably large numbers. We have black chestnuts growing in this neighbourhood, grown from the seed about twenty years ago, that have now a spread of full forty feet,

with about that height, and with from fifteen to eighteen inches at the base of the trunk, which have been bearing nuts some considerable time. They grow with a surprising rapidity, and planted thickly, say six or eight feet apart, will tower to a great height in a comparatively few years. All over this section of the country they originally stood in great numbers, and of the finest and most surprising proportions, towering more than a hundred feet upwards, with a trunk as straight as a line for seventy or eighty feet, and as majestic as Pompey's Pillar, three to four feet at the base. We can get the young walnuts in about four years from the seed to be from six to eight feet in height, and strong, stocky trees, and that transplant with certainty and ease. In our estimates of the trees of usefulness and beauty I suppose few would not like to have left out of the estimate a notice of

THE EVERGREENS.

In these interesting and beautiful trees my best success has been with the pines, spruces and cedars, both foreign and domestic. I might just mention that I have in my possession and growing on the place a block of Austrian and Scotch pines, about half of each variety. They have been allowed to grow up where they were planted in nursery rows eight years ago, and are now about twenty feet high. This block of pines is now the admiration of all who see it in its bold and sturdy outlines of green, and is quite a belt of protection and a wind-break for the rest of the plantations beyond. Though the wind should blow with all the severity and fierceness of old Boreas from the north or west, yet the climate beyond remains quiet and undisturbed. As a harbour or nesting place for the birds it is all that could be desired. The musical songs and chirpings of these beautiful and charming feathered visitants give great delight, and fully attest their birdish appreciation of so provident a piece of tree planting. All my trees are planted in their infancy in nursery rows, three and a half by one foot, to properly prune and cultivate and raise them up for their future place of usefulness.

THE SEEDS

are gathered by practical seed gatherers when desired in large and varied quantities for the trade, but for private purposes and when wanted only in small quantities they can be readily gathered just as they are needed, as the case may be. But in all efforts in gathering seeds, whether in large or in small quantities, either for public or private use, they should inevitably be gathered and preserved as early as possible after the maturity of the variety. Intense drying or long exposure to the sun or winds after maturity has the invariable effect of injury to vitality, and, if prolonged, of total destruction. Nature's methods in this matter in almost all cases is to drop the seeds, that is, commit them to the tender bosom of mother earth and carefully cover them up with fallen leaves and other debris, and thus preserve them with a little moisture in their coverings or cases. Then at the proper or appointed time they will almost certainly spring into life and beauty, and show the upward plumule which is destined eventually to stretch high into the realms of towering and giddy space. The seasons of maturity will be in almost all cases indicated by unmistakable signs, well understood by the practical forester who observes nature's delicate and provident operations. Some trees ripen their seeds in early summer when the year is yet young, while others not until late in the autumn months, or ripened by the frost. But at all times the practical seed-gatherer will be on the look out for the precious germs of future tree life and catch them in the most fortunate time. With respect to the

PRESERVATION OF SEEDS,

much is to be learned from practical experience and positive knowledge of their individual requirements and needs. Some will keep for a winter easily in almost any dry and sheltered place, while others are more fastidious and will require nice conditions of atmosphere and moisture to ensure their immediate germination and successful growth and development. We cannot think of a seed without being filled with wonder and admiration at its mysterious contents and their unfoldings! The whole future life and beauteous developments of the tree starting and being multiplied by apparently such

simple means, is amongst the greatest wonders of nature, and tax our feeble powers of comprehension. The sowing of the seeds should in this climate, in almost all cases, be done in the opening year, the season when nature delights to manifest herself in all her early vigour, and in all her young and buoyant beauty, when everything that has life is pushed into activity. They should in all cases be sown on well prepared and thoroughly drained land, formed into warm and mellow seed beds, and as early as the season will allow. I like to cover those beds with shading or screening, to imitate as closely as possible the tender protections of the parent tree. They are there grown for a year or two, and are afterwards carefully transplanted into nursery rows, as before stated, to prepare them for future plantings. In the present condition of our experience to question whether

TO PLANT THE TREES OR SOW THE SEEDS

has no bearing upon us. None of our experienced foresters should for one moment think of such a procedure as the sowing or planting of seeds in places where future trees are to stand. The better practice is to take a fine strong, vigorous four or five-year-old tree, after proper preparatory culture and training, and plant it at once in the place where it is to stand for the remainder of its life. In this way, whether the plantation is to be thick or thin, whether scattered or condensed, we get the best developments of beautiful and useful trees. I usually keep the young trees in training in the nursery rows some three or four years, or say, till the trees are six to eight feet in height, and during this whole time they are kept perfectly clean and thoroughly cultivated by means of horse cultivators and hoes. They are then taken up and as carefully planted permanently in the places where they are designed to stand for life, either for timber or for ornamental or protective purposes. For timber they are planted in rows on well prepared and well drained soil, four by three feet, to give them a strong, straight, upward growth, and to prevent too much side growth, as we want from the first, straight and towering trees for future use. After a few years growth, when crowding is distinctly noticed, they are thinned by cutting out close to the ground every other tree in the rows, leaving them at distances of six by four feet. After a further time other cuttings are made, to thin them again by cutting out every other row, leaving them at distances of six by eight feet, and so on *ad infinitum*.

THESE CUTTINGS

may be made use of for various useful purposes in the farm or garden work, or they may be profitably sold to the trades for usefulness in their work, as for poles for barrel hoops, for withs, or even fence posts, etc. ; and the small brush is used at home for drains and other purposes too numerous to mention. If, instead of sowing the seeds of trees, you wish to go to the woods and gather seedlings for transplanting (a practice giving very good results), be sure to take up only well formed, well rooted, and quite small trees, say, not over two feet in height, as these can be planted at once in nursery rows, and thus save about two years of valuable time, and much other vexing labour and expense in your operations. Give them good culture, as before noted, and they will in a very short time give you great satisfaction, and will ultimately make a rapid growth and fine trees that will well repay you for all labour and expense bestowed upon them. The kind of timber trees I would advise to plant for rapid and profitable results are the maples, in great and splendid variety, the elms in three or four varieties, the two ashes, and several of the stately and royal oaks. I will also mention, as very desirable, the black and white walnuts, the chestnut and the hickory, also the basswood, the tulip tree and the beech. Of the evergreens, the pines, the spruce, and the cedars are very pleasing. Any or all of these fine native trees will give the very best results, and astonish by their rapid and splendid growths.

My last advice is, by the preceding descriptions of trees and their management from infancy, cut down to a minimum. I may say, however, that I would prefer nursery grown seedlings in preference to forest seedlings for plantings, as I think the former will pay for all extra expense upon them on account of their superior excellence for planting. Again, I am a firm believer in the advantages of frequent transplantings

of trees while young, in order to get a better and more massive growth of surface, fibrous roots. This may look paradoxical at first, but abundant practice fully attests its trustfulness and value.

I believe it would be of immense advantage to farmers to teach their sons (and even daughters, too) to cultivate small patches of ground for the express purpose of making frequent sowings of tree and shrub seeds. These could be transplanted carefully while young, and by training and culture they would soon have many choice and beautiful specimens of forest and other trees to plant permanently over the homestead, to beautify and protect. These trees could be readily and cheaply planted as isolated specimens on the lawn, to give pleasure and pride all the year round, or they could be planted in belts for wind-breaks and storm shelters around the orchards and fields, or in groves around the buildings and the home. Again, I would earnestly advise that by some means or other yet to be devised, that every owner of a farm, lot, or of a village, or a town lot be encouraged to do something annually at tree plantings, either fruit or ornamental, and by this means to keep plenty of trees on the landscape. It is only by feeble attempts in small beginnings that great achievements can be effected. If we each and individually wait to plant large blocks of trees to cover the face of the land, and so to astonish ourselves and our neighbors by our stupendous efforts, we shall not in all probability do much, either for ourselves or our neighbors. The aggregate of every man's small efforts in this line over the face of this beautiful country will amount to much, and eventually be the means of redeeming the country from deforestation and sterility, with all their attendant misfortunes.

You will now allow me as briefly as possible to give you a few

EXAMPLES OF EVERGREEN GROWING

made in this section of country, and of the beneficial results experienced. A few days ago I and my "better half" went over to Mr. James Bissel's pretty place, about a half mile north of the village of Thedford, on the fourth concession of Bosanquet, and a station on the Grand Trunk Railway. On a very showy place, beside the public road, and about ten rods from it on a deep ravine, Mr. Bissel placed his dwelling and home gardens. On the north and west sides of the home and garden spot he planted a belt of Canadian white pine (*pinus strobus*) on the 6th of May, 1876, or eight years ago. He went to the adjacent pine openings and took up, with the best of care and knowledge he was possessed of on the subject, a quantity of fine, young, thrifty trees about six feet in height, and carefully and as quickly as possible transplanted them around his lot on the sides indicated, in one continuous row, about six feet apart. It was a grand success, and the trees grew without much difficulty, and have since made a fine, strong, progressive growth, in height and dimensions perfectly satisfactory, being about eight or ten feet in diameter of spread at the bottom, and twelve or fifteen feet in height, with a thickness at the bottom of trunk of six inches. Mr. B. told us that in winter time his family experienced quite a sensible and feeling difference between the inside and the outside of this belt, and that the temperature and fierceness of the winds did not appear within several degrees the same upon the inside as upon the outside, where he had to go if he wished to ascertain the full power of the blast that was raging without. On the land on the inside of this belt and surrounding their home they grew fruits, such as apples, peaches, grapes, etc., with vegetables and flowers, with tolerable and encouraging success. But

THE BEST EXAMPLE

of this kind of tree planting and a model of the kind I wish to get at is furnished by Mr. R. Thomas, on his place, a little further north of Mr. Bissel's. Mr. Thomas is said to have come originally from Wales, with a good practical knowledge of agriculture and horticulture from his youth, and bought his lot of fifty acres with some improvements on it, some fourteen years ago. He told us, in conversation, that at that time he found it exceedingly difficult, in times of winter storms, to stand outdoors to chop wood or to do any outside domestic work, and that this state of things suggested to him the idea of planting a good belt of pines around his home, to include also his garden and orchard.

He consequently, thirteen years ago, set to work to plant young native white pine trees, on the north side thirty-five rods, and on the east or front of the lot and west ends, twenty rods each, making a total of seventy-five rods. On the following year he planted also the south side, being so well pleased with the previous year's work, thus making a total surrounding of his home-ground and including nearly four acres of soil. They went for the trees to the open pine slashings, and took up, nice, young, branching, forest seedlings about six or seven feet in height, from open spaces, having good roots and as much sod as possible still adhering on them, and as quickly as possible, planted them carefully in their places, most of them twelve or fifteen feet apart, and others only about six feet. They grew with remarkable readiness and beauty, scarcely five per cent. of them dying, and these were uniformly filled in the next spring. On approaching this plantation to-day, it is a most conspicuously attractive spot, and at all times inviting to the gaze of the traveller. Situated as it is by the side of the public highway and on an eminence, it is seen for long distances. Its long and beautiful branches, with their wealth of refreshing green, gently waving in the summer breezes, formed a scene we loved to look upon. From what we saw, we could readily imagine what kind of protection this belt would afford from any direction against winter storms and piercing winds. We found some of the trees to be eight or ten inches through at the bottom and regularly and thickly branched, their whole length fifteen or twenty feet in height, making a regular and progressive growth of about two feet per annum. On going into the enclosure it seemed as though we were in an amphitheatre of beauteous proportions, with those charming pine branches gently waving in the winds on all sides of us, as if in perpetual and ceaseless motion. Within, besides being the home, there were the vegetable gardens and a large plantation of apple and peach trees that had already reached goodly proportions, although yet quite young. On the apple trees the branches were hanging, heavily loaded, to the ground, with a regular, clean and very promising crop of fruit. The trees looked better and healthier, with better leaves and cleaner and better fruit, and more of it, than had the generality of those in their neighbourhood. Although there are not, this season, many peaches on the peach trees, yet this gentleman told us that they had in other years raised many very heavy crops. On the whole, this was the best specimen of a wind-break, both as regards beauty and usefulness, we had ever seen, and the *beau idéal* of what we had often tried to picture to ourselves in our frequent communications. After a little more questioning, Mr. Thomas said that now he could stand to cut wood in a storm with his coat off and be comfortable, and that he considered it worth to his farm \$500, nor would he like to sell it at that, if not to be replaced. Another point that struck us forcibly was the value and beauty of our admirable Canadian white pine as a tree. I had often attempted to contrast this pine with the imported Austrian and Scotch pines, hardly being able to sustain the comparison. But this plantation has completely turned me over in my judgment, and I will now cheerfully vote for the native Canadian born on our own hills and towering in our fertile plains. Is not this as it should be and agreeable to our cherished motto, Canada first? The points of excellence seems to me to be—1st. A beautiful, clear, refreshing green colour of leaf, delightful to look upon. 2nd. Long, swinging or swaying branches constantly in motion in the summer breeze. This contrasts finely with the stiffness of the other two pines. 3rd. A regularity from bottom to top of branches decreasing in length, but with a dense fulness of branch and leaf, giving a deep fulness to each individual tree without any break in it; and 4th, nationality. It in every case and in every place reminds you at once and forever of our beloved Canada.

A short distance further to the north of these plantations and on the same line of road there is one of the most admirable blocks of many acres of natural growth of white pine from seedlings in open pine choppings that is to be met with in the country. About twenty-five or thirty years ago the large and noble trees from this pinery were removed, and the land, left merely fenced and protected from the inroads of cattle for a few years, is now densely covered with as handsome a growth of young and promising pine as could possibly be desired. Their beautiful deep green and long slender branches on all outsides, and open spaces, are very attractive, and the traveller passing them is compelled to admire their beauty and to wonder at their rapid and astonishing

growth. I suppose there may be twenty-five or thirty acres of this kind of natural plantation in the block, and the trees have now reached a height of twenty to twenty-five feet, with a good bulky thickness of trunk. This pine in a few years more will afford to the people much of value in evergreen branches for shades, coverings, and decorations, and also in young and valuable timber for many useful and indispensable purposes. In expense it has really cost the owners nothing but the taxes on the soil.

Mr. Bissel mentioned a point in conversation that is of special interest to them, living, as they are, just south of the shores of the great and majestic Lake Huron. They were formerly protected from the cold winds coming over the lake from the north and sweeping with great force over this whole region during the winter, and even the spring months, by a dense belt of Norway pine, that was found growing on the sand hills in a continuous line, parallel with the shore, and reaching for many miles. This mass of pine raised a most effectual barrier, to the height of about one hundred and fifty feet above the water, to these cold and destructive winds. This had the effect of greatly protecting much of the country that lay many miles to the south of it, including a fine agricultural country of many thousands of acres in the counties of Lambton and Middlesex. This whole country and belt of timber were in possession of the "Canada Company," being a company of English land owners, and they through their agents saw fit in their wisdom to give permission to have the whole of this timber sold and removed in very recklessness. Now at this present, these hills are seen in the distance to be bare mountains of sand, sand, uncovered with their usual dark and dense mass of green, and the wind barrier is in consequence lowered fully fifty feet. The effect of this removal is now being felt by the people of this entire region of country, in the increasing cold of winter, in the greater severity of their wind storms visiting them, and in the frequency and severity of the destructive and much dreaded spring frosts late in the season. Surely there is not always wisdom in great corporations, much less if those corporations are foreigners and unacquainted with the conditions and reasons of things. This instance forcibly opens to us the absolute need existing in the most of our locations, even thus early in our history, for self-protection against the increasing force of cold and wind storms by judiciously planting trees around our homes, our orchards, and our fields. The wisdom of depending upon others is not always safe wisdom.

Yours,

B. GOTT.

Arkona, August 26th, 1884.

I have great pleasure in laying before my readers the following statement, procured from Mr. Ross, one of the most thoroughly practical tree cultivators in Ontario. All he has stated here is based on his own experience of years, both in working with his own hands and in directing others. There will be found complete rules for gathering seed, sowing it, transplanting the young seedlings into nursery rows, transplanting these again to the places wherein they are designed to stand; with full statements as to the classes of trees most suitable, and the soil, time and manner fit for the prosecution of each operation.

GROWING FOREST TREES.

By J. McPHERSON ROSS.

The growing of any of our native forest trees from seeds is a very simple performance, and calling for no particular skill or experience, as the same care requisite for the successful growing of a crop of roots or grain will suffice to raise thousands of tree seedlings. All that is necessary is to be careful and attentive to the various details that will be mentioned here, and success is certain. Neglect and indifference will ruin everything. The best time to sow the seeds of any tree is at that period when they are ripe. For the sake of con-

venience I will place the various trees in groups, noting the time that the seeds of each group are ripe. The first group will be the *nut-bearing trees*, such as the

Oaks, in variety,
Walnut,
Butternut,

Hickory,
Beech,
Chestnuts, in variety.

I need hardly mention that the nuts will be ripe in the fall. As a certain time to gather them all in the different localities through the country, I will say about the 15th of October. Of course many are ripe earlier in the year, and all may be gathered at any time after the 1st of October. A sharp frost will facilitate the seed gathering. The gathering and after care of the nuts I will notice again. We now pass to group No. 2. In this I place the trees that ripen their seed in June. These are elms, in variety, as our

Slippery Elm (*Ulmus Fulva*),
White Elm (*Americana*),
Wych or Scotch Elm (*Montana*),
Corky White Elm (*Racemosa*), and
White or Silver Maple (*Acer Dasycarpum*),
Scarlet or Soft Maple (*Rubrum*).

In group No. 3 I place the deciduous trees of all kinds that ripen their seed in the fall, the same time as the first group of nut-bearing trees, as follows :—

Hard or Sugar Maple (*Acer Saccharinum*),
Norway Maple (*Acer Platanoides*),
Ash Leaved Maple or Box Elder (*Acer Negundo*)
Butterwood or Plane Tree (*Platanus Occidentalis*),
Birches, in variety (*Betula*),
White and Black Ash (*Fraxinus*),
Basswood and Linden (*Tilia*),
Locust or Acacia (*Robinia*),
Wild Cherry (*Cerasus*),
Alder (*Alnus*),
Mountain Ash ;

and in the group No. 4 I include all the evergreens in their three sub-families, pines, spruces and cedars, the seeds of which are also ripe in October.

To return to group No. 1, I find the same treatment required to grow any member of this class successfully applicable to them all, and any directions given as to care of seed, sowing, mulching and transplanting equally apply to all walnuts, oaks, etc. This the reader will please bear in mind. To keep nuts after being gathered in good condition for planting it is necessary that they should be kept moist, or not given undue exposure to sun and wind. They should be kept in boxes or barrels with a little damp sand or earth mixed with them till the opportunity arrives for planting the nuts. By all means sow them in the fall, if practicable at all, but when they are procured from distant places, and it is not possible to sow in fall on account of late arrival, place the nuts in thin layers in boxes, sprinkling through them sand or earth, and leave out-doors in a shady spot where they can remain frozen, or keep them in cool cellar where, if they do not freeze, at least it will not be warm enough to cause them to grow before time to sow outside. Or another plan is to dig out a shallow pit, say one foot deep and dimensions to suit quantities of nuts on hand. On the bottom of the pit strew the nuts evenly and thinly, sprinkle them with earth or sand, enough to cover them so as to protect them from being destroyed by mice or other vermin ; then place over all a covering of leaves or strawy litter, placing thereon a few heavy pieces of timber to keep the covering in place from being blown about or disturbed by winds. In the spring of the year the nuts will be found in fit order for planting, which should be done as early as possible. But, to return to fall sowing, I strongly advise to sow all tree seeds ready in the fall, as this is the natural time for such work. An observer of the woods readily understands how Dame Nature provides for the future growth of trees ; the seeds or

nuts fall when ripe, then the leaves fall, covering the seeds with a careful cover, or, as tree-growers term it, a mulch. The leaves not only protect the seeds from all extremes of exposure, but also furnish, when the warm weather sets in and the seeds sprout, the tiny plant with moisture and food as the decaying parts of the leaf resolve themselves back into the elements. Then a safe rule to all growers is to follow nature by observing her simple laws and copy them. I now go into the details of the *modus operandi* of growing trees from seeds, the general rules of which apply to all kinds, and which may be summed up in the one sentence, *i. e.*, to sow the seeds and cover them. But as it is here necessary to give the fullest information which experience has taught, and which I do gladly, I will confine myself to directions necessary for growing groups 1 and 3, leaving the other two groups for the present, as they call for remarks and notes peculiar to each, but which agree in the main with what I am now about to observe.

SOWING THE SEED.

Having the seeds of all kinds ready for sowing, we now come to the soil proper to grow them.

For this purpose select a piece of land naturally dry, in good clean condition, just such a piece as any good farmer would consider capable of growing a good crop of anything on the farm. The soil *must be* on top a sandy loam. This is absolutely necessary for this reason: Sandy soil is not subject to upheaval by frost as are clay soils. Seeds sprout through a sandy covering easier than through clay, as this last frequently bakes into a hard crust which it is almost impossible for the young seeds to push through unless the crust is broken carefully with the fingers or an instrument—a delicate job, and no matter how carefully done, sure to be fatal to many of the young shoots alike in all nut-seeds, which resemble in a measure young beans and are equally brittle in their formation. Where it is not possible to have a seed-bed of a light sandy loam, and a person has to sow on clay, be sure and cover the seed in the drills it is sown in, and fill the drills to the surface with sand brought for the purpose. It does not matter what the quality of the sand is. A sand the same as builders use will answer capitably. A piece of land selected for a seed-bed should be deeply ploughed or dug; the surface should be even, and not too flat, so that no water will remain to cause stagnation and destroy the nuts or seed. When all is ready make the drills the full width of the hoe, which would be six inches and about two inches deep. Now sow the nuts thinly—large nuts, as walnuts, horse-chestnuts, etc, about four inches apart in the row; acorns and smaller ones a little thicker, but as the after growth is about the same, the same distance will answer. Cover evenly with soil and tread the drill firmly. For sowing tree seeds the feet are as useful as the hands. I place great stress on this treading the soil, as this places the nuts firmly in the land and also makes sure of covering the soil over them. After the drills have been tramped rake the loose soil evenly over all. A proper distance apart between the drills would be twenty inches. This distance gives convenience in weeding and hoeing the drills, as all the cultivation of seedlings must necessarily be done by hand. In reference to how deep seeds should be sown, a safe rule is to place the covering of soil twice in thickness the diameter of the seed, so that while a chestnut would be covered with two inches of soil, a beech-nut would have about an inch, and so on in proportion. There are always exceptions to rules, and what a person should strive to attain is, a happy medium. Allowance must be made when sowing the seed for the loose soil to settle so that the seed may be always covered a little more, as the subsidence of the soil will bare the seed more or less. And now I come to the chief factor of success in growing seedlings, and that is the mulching. So long as the seed-bed is covered after sowing with a good *mulching* of any litter, manure, leaves, straw or stalks of any kind, success is certain. As to covering the seeds in the drills, should any mistake be made about not putting enough soil, the mulching will make all right. In fact, seeds sown on top of the ground, if only mulched, will grow and do well. This mulching should be left on the bed till warm spring weather sets in, or an examination of the seed-bed shows the seeds pushing their tender shoots through the ground. Rake the mulching into the space between the drills, where it may be left if of a fertilizing nature; here it will keep weeds down and the soil moist. If, however, it be of a bulky nature and might impede the growth of the seedlings, have

it removed and commence the cultivation of the seedlings the same as you would a crop of carrots,—hoeing, weeding, etc.

We have now the seeds growing and the first season passed over. In the seed-bed plants of maple, ash, birch, chestnut, elm, and all fibrous-rooted trees, may be left two years; but as the roots on all nut trees are tap-rooted, it is necessary to take them up the following spring if they make any vigorous growth. If they do not, then you may leave them two seasons, but no longer. Another reason for not disturbing the seed-bed too soon is that very often seeds lie dormant the first year and come up the second. The seed of the ash sometimes will thus remain dormant. After two years of growth in the seed-bed our seedlings will be ready for transplanting. As early in the spring as the ground will allow for digging have the seedlings dug up. They should be assorted in two sizes, the large and the small. With a sharp knife cut the leading and tap roots back to within six inches of the collar. Do not touch the tops at all, tie them up in convenient bunches for handling, dip the roots in a thin mud and heel in ground convenient to your work. The best soil to grow all kinds of trees in nursery rows is what is known as a sandy loam with a clay bottom. Select a piece answering that description, and have it prepared as for any farm crop. To prepare it properly it should be summer-fallowed the season previous, but that is not necessary though desirable, as any land in fair tilth will answer. Having it ploughed and harrowed, set the line parallel with the longest way of the lot, if most convenient to cultivate that way. A good strong garden line is the most useful and indispensable article in the planting of trees. The line set, level all inequalities of the soil with the spade under the line and pat the soil down firmly by striking with the back of the spade on the line. The next operation is to cut out the drill by striking with the edge of the spade parallel with the line run, as it were to split the line. A little practice will make a handy man very expert and exact in cutting the line, as it is termed in nursery parlance. The drill is now dug out a spade wide and the soil put neatly on the opposite bank from the line—the bottom of the drill being evened with the spade as the digger goes on digging out the drill. All is now ready for planting, and the planter, provided with a bundle of plants, stoops and places a seedling neatly against the bank, placing the collar of the root evenly against its edge. Another person at the same time places a spadeful of soil with a quick turn of the spade snugly and securely against the roots of the plant. So the planting goes on, and as the planters get more expert, they can place the plants as fast as a slow walk, as we might say, to use a paradox. The plants want firmly treading and straightening, and the balance of the trench may be filled in and levelled off. A convenient distance for any kind of forest tree in a row would be one foot apart, and the distance between rows four feet. This allows cultivation with cultivators and single plough by horse and man, and is in every way convenient for growing trees straight and in good shape. Out of these rows the trees may be transplanted at any time, spring or fall, to other places, or if the idea is to leave them there permanently they will succeed. After growing three or four years every second tree may be dug up and transplanted. After four or five years' growth every second row may be removed entirely, thus leaving the rows eight feet apart and trees two feet apart in the row. In this arrangement on fair soil the trees may be left to grow to form timber or wood. The strongest will now survive, and any weakly ones can be removed at the option of the cultivator. I again repeat that very little experience, with an observant mind, will soon teach a person how to grow and manage the trees for forest cultivation. Before mentioning anything further connected in a general way with tree-growing, I will return to group No. 2, consisting of elms and maples, ripening their seed in June. As soon as these seeds are beginning to flutter to the ground the main crop on the tree will be found ripe enough for gathering. As these two trees are two of the most important classes of trees we have in our whole list of forest trees, having so many qualities in the value of the timber for firewood, lumber and every other use to which these useful trees may be applied, the importance of their position in the landscape of the country and many other qualities, had we time to mention, it is a great blessing or boon to know that they reproduce freely from seed, also that the trees bear great quantities of seed, also that they ripen in summer early, in time to allow of the seed being sown there and then, and that it grows the same season, making a foot or more of growth the one season. The same directions as mentioned before are now applicable to the elm and maple seeds. I must repeat, when

sowing the seed be sure and tread it in firmly—the same distance apart in the rows, and after cultivation, as mentioned before in connection with transplanting, etc.

On good deep soils the seeds and nuts of trees may be sown where they are intended to remain; a couple of years' clean cultivation afterwards will enable them to take care of themselves. On thin light soils they will be better to be transplanted so as to induce a lateral growth of the roots. I now draw attention to the evergreen class. Hitherto young trees of all kinds of evergreen have been easily procured in abundant quantities from neighbouring woods and swamps. There are still great quantities to be easily secured; nurserymen and large planters have drawn their principal supplies from the woods, and as they have always been able to secure their stocks without much trouble, very little attention has been paid to securing seed and growing it. The white pine ripens its seed in the fall; the cones may be gathered whenever convenient, late in the fall or through the winter; by exposing them in a warm dry room the scales of the cones open and allow the seed to drop out. This should be gathered at once, as mice are very fond of resinous seeds and would destroy them as fast as they drop out. A good plan to secure the seeds of pine and spruce easily is to cut the branches having the cones on, tie them up in neat bunches, cover all up in muslin and suspend from nails in a warm place, over a stove or other heating arrangement; have the mesh of the muslin small enough to retain the seed; after the seed is all out put it up in paper bags and keep in a dry place. The seed of the cedar should be sown when gathered in the fall, either in drills or broadcast in small beds enclosed with boards, covering lightly with soil in which a goodly quantity of sand is incorporated, and mulching over with leaves. In the seed bed they may be allowed to remain three years, when they can be carefully transplanted to other places in nursery rows—select a damp, partly shaded spot for sowing the seed. A similar plan will answer for the pines and spruces. The most necessary element in the successful growing of evergreens is keeping the soil in a uniform state of moisture, alternate damping and drying of the soil being fatal to seedlings. Persons familiar with the country and tree growth will have often noticed the thrifty little pines, hemlocks or cedars, growing on the damp hillside generally facing north. Here self-sown they rear their rich green foliage to the passing breezes and blue skies above. A moment's reflection and study will convince any person of the proper and essential rules to be observed in growing young evergreens. They are, a uniform moisture of the earth, the soil to be of a dark rich loamy nature, full of sand and leaf mould, plenty of air and partial shade. Any system embodying the foregoing principles must be successful. Evergreens, when small, thrive planted closely together. They thus afford mutual protection to each other, from the density of the foliage preventing the wind from a too boisterous acquaintance, shading the soil, keeping it damp and cool. So it follows when planting in nursery rows, plant them any distance that the outer branches just touch each other, and the rows far enough apart to allow cultivation easily. As the trees continue growing in size, keep thinning them out either in the rows or by taking each alternate row out altogether. One rule to observe in the cultivation of evergreens is that they thrive best by themselves, not when planted indiscriminately amongst deciduous trees. They will grow on poorer and thinner soils than deciduous trees. It does not follow, however, that they require poor soils to grow in; like every other plant, they thrive in a corresponding ratio to the treatment they receive, and will grow better on good soils than on poor ones, etc.

Persons convenient to woods and places where young trees are to be found are fortunate in being able to secure young trees all ready, without the trouble of waiting to grow from seeds. They can thus commence plantations right away, and may begin either in fall or spring. If in the fall, the best time would be after a fall rain, or say about the fifteenth of October. That is a safe time to go about doing fall work in the way of planting and getting trees. In damp situations the plants can be easily pulled without injury, but where they will not draw easily it will be necessary to carefully dig them up. When all are gathered, that time and opportunity will permit, they should be packed tightly into the wagon-box or in cases, same as used by nurserymen for shipping. Do not expose long to wind or sun, but keep in shade of trees, or cover with moss or leaves till ready to pack for carrying home. Arriving there, they should be unpacked and sized in two or more sizes so as to make them of uniform strength. With a sharp knife, trim the tap

roots off, as advised before about seedlings, leaving about six inches of a root ; this makes the plant neater and more convenient for handling and planting, besides inducing an after fibrous growth of roots which will make them easy for transplanting any time afterwards.

PREPARING THE SOIL.

Land intended for using as a nursery for growing them in should be clean and in a state of fair tillage. Any soil that is considered fit to raise a good crop of grain or roots will answer capably for trees. I have now reference to young seedlings of maple, elm, ash, and all hardwood trees. Poplars, willows, and trees of a softwood nature will also do well on these soils. But in all cases my experience of tree growing goes to show that the better condition of the land the more the growth corresponds and *vice versa*. If you have a piece summer fallowed to spare, all the better. In this you can at once commence to plant. Make a neat and careful job of the business—and we know it always pays, to be careful—as the satisfaction you afterwards enjoy after the work is done will more than repay the extra trouble.

I would now say, plant in the fall if you can, as spring work on the farm generally crowds outside intentions, although I trust tree planting is not a foreign or side speculation, but should be a very important operation on every farm. If not convenient, however, to plant in the fall, heel your plants in some location where they will not be disturbed by trampling under foot or be nipped by cattle. April or May is the time, however, to get plants in the spring. All seedlings, but particularly evergreens, should be procured at that time, particular care being used to keep the roots of all moist, especially the evergreens. When planting in spring, it is well to dip the roots of all in thin mud just before planting. When not convenient to procure young plants from the woods, quantities of all varieties can always be procured from nurserymen at very low rates. In the old country they make a specialty of growing forest tree seedlings. There they are offered by the tens of thousands, as forest tree planting is practised on an extensive scale in Europe. The following is a list of the trees which are grown principally, and which succeed and do well here :

Norway Maple (*Acer Platanoides*),
Alder (*Alnus Glutinosa*),
European Birch (*Betula Alba*),
European Ash (*Fraxinus Excelsior*),
European Linden (*Tilia Europea*),
Scotch or Wych Elm (*Ulmus Montana*),
Norway Spruce (*Abies Excelsa*),
Austrian Pine (*Pinus Austriaca*), and
Scotch Pine (*Pinus Sylvestris*).

Any of the above may be imported from Europe during the month of March. They are packed to carry safely to any part of the world, and are sold at very low rates by the thousand. There is no doubt but that the time has arrived when planting must be carried on on a large scale so as to make some provision for that future which is rapidly nearing us. There is no doubt but in clearing of our woods in the thorough manner we have done in the past, that we have sold our birthright for a mess of pottage. It does not tax the memory of the writer very much to remember a few years back, within a few miles of Toronto, of rippling streams the whole summer long ; of cool wooded banks and leafy glens, of hillsides at whose base pure springs of the coldest water could be had, and often speckled trout and water cresses ; of ponds where schoolboys could go in and bathe, and shout and splash like "troutlets in a pool." Now these are bare and bleak hillsides, parched and burnt, and seamed with lines ploughed deep with frost and storm. Where the gurgling stream pursued its way is a long thin white line like a skeleton of bones and stones—in the spring thaws a roaring flood for a day or two, and then silence for the rest of the year, excepting, perhaps, a thunderstorm and a few hours' stream, and all is over. Railroads are continually cutting their strips through and around the woods ; the lumberman's axe is continually ringing in the bush ; joined to these, fires cause terrible destruction. Some

expeditious method must be adopted, that, while it will not hinder the progress of improvement, yet will conserve the woods in a way that will furnish a continual supply for reforestation. It is a well-known fact that our climate is steadily undergoing a change not for the better from this continuous clearing without replanting. Nature makes every provision for new forests and plantations by the abundance of seeds each tree bears for its reproduction, and, that the cultivation of timber is remunerative there is no reason to doubt. Any person can satisfy himself as to this fact by visiting any of our established nurseries or parks in cities, or observing the trees planted in the streets, where the costs may be figured and the cords of wood for firewood, or other uses timber is put to, may be estimated at their proper value.

PLANTING NEAR TORONTO.

The following communication from George Leslie, Sr., of Geo. Leslie & Son, Toronto Nurseries, gives the opinions and practice of, I believe, the oldest nurseryman in Ontario. Mr. Leslie is in his eighty-fourth year, has passed his long life in tree cultivation, and is an enthusiast in his vocation :—

If trees are planted by the acre, ten acres or more, they should never be planted in rows ; planting in rows is never practised in Europe where thousands and thousands are planted every year. They are planted in, or dotted in, as the ground suits, among rocks and stones from three to five feet apart. Plantations set for timber and other uses are better mixed with evergreens, such as spruce and pine trees. Those procured from the nurseries are always the cheapest. Where the ground can be ploughed deep it helps the growth of the trees. In 1848 I imported the following sorts from Europe : Larch, Norway Spruce, Silver Spruce, Australian Pine, Scotch Pine, Siberian Cedar, Norway Maple, Sycamore, Scotch Elm, English Elm, English Ash, Beech, Oaks and Turkey Oaks, European Birch, a noble tree ; Scotch Alder, or Mahogany, as it is called in the old country, a splendid tree for the North-West ; it grows very fast—makes fine furniture. Hornbeam is hardy and makes a fine hedge. Specimens of all the hardy European and American forest trees of large size can be seen in our grounds, some of them measuring over two feet through. The Chinese Abele is the best tree that can be planted in the North-West. All sorts of willows are valuable for shelter ; the Huntingdon Willows are the best of the sort, growing fast and straight as a Lombardy Poplar. The foliage is silvery ; it is new in this country.

PROPAGATION.

The following trees are easily raised from seed, if sown in proper season : Maples of all sorts, Birch, Elms, Sycamores, Mountain Ash, English Ash, Alders, etc. Should be sown in summer or autumn, as seed is ripe. Cuttings should be made in the winter. All the trees that grow from cuttings should be buried in the ground where the frost will not touch them, and planted out as soon as the frost is out of the ground.

PLANTING IN RHODE ISLAND.

The following statement from H. G. Russell, Esq., Rhode Island, gives an idea of the pains which are being taken on that exposed coast. Where probably a forest stood, and has been unwisely cut down, they are planting trees by the hundreds of thousands to obtain another. It is certainly likely that if the descriptions of trees mentioned succeed well on such soil as is here described, many of our poorest soils can without difficulty be reforested :

I am glad to give any information I possess in regard to Forest Culture, but I fear I

cannot enlighten my readers very much, as this is quite a new enterprise in all parts of the United States. I can only tell you what I have done in tree planting on my farm, situated about fifteen miles from here, in Warwick, R. I.

I do not know of any other person in this vicinity who has planted forest trees on anything like a large scale, although a number of my friends are taking quite an interest in what little I have done, and I feel encouraged that my experiment may induce others to plant largely in forest trees adapted to our soil. I think if a large part of the poor soil of New England could be planted in forest trees, it would return more money, in thirty or forty years, than in any other disposition that could be made of it.

My farm is a long and narrow one, containing about six hundred acres. I have on one side about two miles of shore, being an arm of Narragansett Bay. This shore is much exposed to north winds, and my object is to plant a belt of trees the whole length of this shore, from six to eight hundred feet wide, which I trust in time will make a break-wind for the rest of the farm, thereby improving the land for cultivation. The soil of my farm is poor, being a sand and gravel sub-soil, therefore I have confined my planting to the kind of trees that are supposed to do well in this soil. My first planting was commenced in the spring of 1877, when I planted seventy-five thousand European larch. These were small seedlings, planted in rows about one foot apart, having been once transplanted, and about six to eight inches high, and not much larger than a knitting-needle.

I have continued to plant every spring since, and have now more than half of my belt planted. Inside of the larches, I have planted white and some Scotch pine, and among the larches I have dropped about every two feet a white oak acorn, all of which are doing well. Some of the larches of the first planting are now over fifteen feet high, and three to four inches at the butt. Some of the acorns are now little trees several feet high and promising very well. I have also planted Norway maples, sweet chestnuts, and the Corsican and Austrian pine. Thus far the white Austrian pine, European larch, with the Norway maple, chestnut, and white oak, as deciduous trees, are looking the best.

I think more of the Scotch pine when planted as a nurse for other trees, but their roots on my soil run so near the surface of the ground they are liable to blow down when fifteen or twenty feet high, and I do not think they will prove as valuable a tree on this side of the Atlantic as when grown on their native heath. I am cutting them out when they encroach on other trees.

I should also add I have planted some red pine seedlings which are doing very well. I have not been able to get many of these plants, or should have used more of them. I have found it best to plant young seedlings, three or four years old, having been once transplanted, placing them in the ground about eighteen inches apart in the rows, and the rows four feet apart, so as to run a cultivator between the rows, which I find helps the young plants very much the first year or two. When the young trees are large enough to shade the ground they will be able to take care of themselves. I have done but little in transplanting from the rows, as I find the young trees put close together, and gradually thinning them out, do much the best.

I have procured most of my young trees from R. Douglas & Son, Waukegan, Ill., who I have found very reliable people to deal with, but the transportation costs so much. I am now trying to raise trees from seed, and see no reason why I should not meet with success. I cannot think of anything more to add, except I feel encouraged and quite sure, if I live long enough, I shall see quite a forest of trees on my farm, which will be more profitable and ornamental than any other way in which I could have used the land. I am very much interested in this work, and shall be glad to receive or give any information.

FOREST PLANTING IN NEW YORK

The article which follows is from Mr. Henry Ives, Batavia, N.Y., one of the most successful cultivators of forest trees in that country. The soil and climate are in most respects similar to what we have in many parts of Canada. Mr. Ives' statements may be fully depended on for their accuracy. An excellent and valuable point in his treatise will be

found to be the directions for growing a circular plantation, after the plan of one which exists in full beauty on his own grounds.

The native *flora* covered a large portion of this new world only a century or two ago, but when civilized man came to occupy the ground, he made it one of the first objects of civilization, to, as far as he was able, denude the land of its noble timber crop, to make place for other crops quite as essential, so much so that a man was famous according as he had "lifted up axes upon the thick trees." But through this process such a great change was wrought upon the face of nature, that as it came to be overdone, both man and beast, and the vegetable kingdom, were left to suffer such scorching heats and blasting winds as only forest growth is capable of protecting a country from; and then (as at this time) men of prudence and philanthropy commence to look earnestly for the remedy. And first, it is found that the small, isolated plot of original forest timber, the wood-lot of the farm, for the agricultural districts, is thinning out and dying out rapidly, mostly caused by the removal of surrounding forest growth which had ever been its protection, while in the timber country the lumberman is fast depleting these original forests of their product. But it is also found that a replanting and a second growth of these same kinds of forest trees will so accommodate themselves to the present conditions in which they are called to grow, that they will soon show a healthy progress. Having had some experience in this planting, and more particularly in the planting of seeds and seedling trees, to rear for propagating forest timber, for lawns and groves, and belts of timber growth for the farm, I have found it all to be of such practical utility and so quickly and easily accomplished, that I would urge it both as a duty and a pleasure for any one who can have the opportunity to practise it, and will state some of my experience in forest propagation, from the gathering of nuts and tree-seeds for planting, to the rearing of the full crop of forest growth. First, if one will notice certain trees now (April), whether in the forest or along the streets of any town, they will see that the buds on many limbs (especially the upper ones) of the soft maple, and the native white (or drooping) elms, and some few other trees, are much swollen. This is for bursting into bloom for growing a yield of seed, which will mature and drop from the trees about the middle of June. As the leaf-bud does not come on until some time later, we may expect, if we see these first buds, that the seed will come in due time; and as there are two very desirable kinds, both for graceful and rapid tree growth, arrangements should be made early for securing and planting their seed when it first falls to the ground. The single winged seed of the soft maple every one is familiar with, though not every one knows that there is the proper time for planting it, but the small scale-like seed of the elm is so inconspicuous that it might be overlooked. This matures about simultaneously with the maple, and to plant them one should prepare ground, about as he would for carrot seed; gather the seed by scraping or sweeping it up from under the trees, and dibble it into rows prepared by slight trenching, and cover lightly. If the ground is moist, they will soon grow, and need about the same care the first year as carrots would, and their growth will be from a foot to a foot and a half the first season, when, if they stand pretty thick in the rows, they should be transplanted, to grow a year or two more before being permanently set for the grove. This resetting of all trees or plants greatly increases their chances in transplanting, by multiplying the number of their small fibrous roots. The seeds of most of the other of our native forest trees mature their seed in the autumn, and depend largely on the moisture and frosts of the following winter, to prepare them for growing when the proper season arrives in the spring. Especially is this the case with acorns, chestnuts, and the product of all the nut-bearing trees. The basswood, or American linden tree, is a rapid grower, gives a clean and dense foliage, and when in blossom yields abundant food for the honey bee, besides a valuable lumber used in the manufacture of cabinet ware and carriages. Its seed is about as large as the field pea, and can be gathered from the tree, at about the time the leaves fall, or later; can be collected from under them, and slightly raked into the garden beds, to grow the following season. The plant at first starting shows two glossy leaves about as large as six-penny pieces, but a strong stock, and its next pair of leaves are plainly of basswood. The rock elm, and hard, or sugar maple, the ash and beech, all want treating in about the same manner to raise their stock from seeds, but unless an unusually large number of these were wanted, it would be found to be very practical to go into the

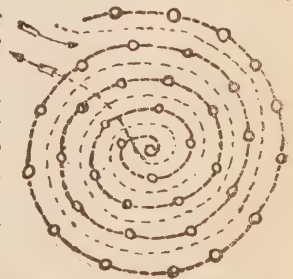
forest where these various kinds are growing, and in the spring when their buds are swelling, so that the kinds can readily be distinguished, pull what amount is wanted of these seedling scions, which are usually found in abundance, that grew the year before to about the size of a knitting needle. These being reset to nursery rows, will make, after two or three years, good stocky trees for the plantation. None of these trees seem very particular as to the soil they grow in ; but it is noticeable that the soft maple, the white elm, and the American arborita, or white cedar, all of which in their native home are found occupying rather low, moist ground, are found to be very hardy, and make perfect specimens of growth on any high, dry land on which the planter may choose to put them. But a different course of treatment will be required for the nut-bearing trees, as they have a tap root. It is desirable to plant their seed in the same ground and place where its future growth is to be, and thus avoid their transplanting, which is always a hazardous and laborious job for this species of tree. Yet in case of necessity, one might undertake to reset these at one year's growth, though that is not to be recommended. Therefore, acorns, chestnuts, walnuts, butternuts and the like seeds of nut-bearing trees, should be gathered soon after falling and either planted directly where they are to grow or spread on the ground, say near the house, covered slightly and left to the action of the winter's frost, which is nature's way of opening their shell so that they can grow. If they are planted in the fall, the rows or hills should be marked so they can readily be found the next spring, so as to nurse and care for them when they first come up. The most practical way to manage that is, if planting in a black soil, to draw a load of light sand loam with which to cover the seed. This will effectually mark it and will facilitate the first tender growth of the scion. But if the other plan of not planting until the spring is adopted, then be sure not to let the nuts get uncovered and dried before being planted. In spring, prepare the seed bed nicely as for turnips, and when the seed shows signs of sprouting plant them out, and till them through the season about the same as corn culture requires ; and for a few following years, either such tillage, or a mulching of these trees will be found very beneficial. To do this the more readily, whether for a single row or for a grove plantation, I prefer to lay out the ground for planting to corn or potatoes, always planting the trees in one of these field rows, so as to take its tillage with the rest of the planted crop. After this seed down the ground (to orchard grass is preferable) and mulch well about the trees, trim them up from year to year, taking all the lower limbs off, to favour an upward growth and straight, smooth-bodied trees. This trimming I follow up until the trees are twenty-five or thirty feet in height, being a growth which acres of my trees have attained in sixteen years from resetting in groves. The oak and walnut are twelve to sixteen feet high, in ten years from planting their seed in the ground, and many of the black walnut trees have borne nuts two years already. For these groves I prefer to plant the rows one rod apart, and one or two plants to the foot, at first. Then thin out and save the best plants, one to every two or three feet in the row. Then, after two or three years, thin out again by taking some to fill any vacancies in the rows, and others to plant out on the lawn or along the border of the highways, or to sell (as I have done enough from a grove of two and a half acres, to pay for the land, and all the cost of rearing this timber growth on it) ; and I might add that this grove, containing nearly all varieties of our native forest trees, and planted out to take the place of the old wood lot of seven or eight acres which seemed to be fast failing me, and set about sixteen years ago, has done so well that years ago I cleared off the old wood lot, and this grove, with what I have planted from it along the road, and the line of lots, is showing a better timber growth than many farmers have in their ten acres of original forest lot. No system of forest propagation is complete without its varieties of evergreens interspersed, but for their production it will require about the same management as for the others, as above described. But for a farmer or for a government to preserve and replenish their native forests, the old trees should be carefully removed, giving place to a new growth and a planting in of seedling trees, and the planting of acorns and nuts to add to the varieties and fill up the stand of timber growth where it is too light. This can be easily done and will prove quite effectual for the object desired. Then these plantings may be safely left to care for themselves for future development. This will be found the most practical and economical way in making any expenditure in forest preservation.

To recapitulate my own experience in propagating forest timber for timber purposes,

in groves, and blocks, and wood-lots, I would say, it has mostly been in the planting of four groves, ranging from a quarter of an acre to two and a half acres, besides rearing two second-growths of native timber of its own replanting, after removing or clearing off its standing crop, one of five acres, and one of twenty acres. After growing the seedling stock, as before described (all except the nut-bearing kinds), I take them at from three to six years of age to plant for the wood-lot, with the rows to be one rod, or say fifteen to twenty feet apart; but as the ground would bear four times as many as four to the square rod, until ten to twelve years of age, I plant them only four or five feet apart in the row. This in their early growth is a great advantage in carrying them upright and straight; but after six to ten years every other tree should be removed, and then after another term of years, as it is found desirable, remove every other one again, reducing the standing timber to about one tree to the square rod. This, from my experience, I believe to be a fair allowance for growing a full crop of timber from the land, of soft maple, or ash, elm, basswood, chestnut, or any of these fast growing kinds. But of hard maple, or oak and hickory, as well as for pine and cedars, some forty years is a better allowance for growth. But by still farther thinning out, the growth of those remaining might be continued for a century or more. As my principal experience is in attending such groves up to sixteen years after setting out, I find the fast-growing ones want reducing to one to the rod after ten to twelve years, but at that age hard maple, hickory, oak and the like, were doing well two to the rod, being thinned out to one to the rod at fourteen or fifteen years (from seed). All the tilling and tending they have required consisted in trimming, and in the first years of tilling (as described), then seed down and mow or pasture. But as I found at first that this rather checked their growth, I remedied it by mulching. For about an acre I drew on several loads of old straw, covering all the ground for about a foot after being trod down. This proved so favorable to their growth that it showed plainly for years, and after four years they had attained about once and a half the size of the other rows. This mulch lasts until these trees, by their shade and their fallen leaves, do completely mulch themselves, and now these trees, (at sixteen years), stand about thirty feet tall, and many of them six to ten inches in diameter, and have already furnished many loads of fuel from the thinning out required. I have always preferred to plant the several kinds separate—that is, a given number of rows first to one kind and then to another—only that as the grove was thinned out the last time, a cedar tree was put in place of the one removed, which filled up the undergrowth with an evergreen. At eight years of age the black-walnut commenced to bear nuts, but the oak has not borne yet. The maple will soon answer to tap for sugar-making. I must not forget to say that the fields adjoining these blocks of timber have shown a better crop growth for the shelter and protection thus received.

The most artistic and prettiest work in tree-planting I ever did was in planting a grove of 160 maples (enough for a sugar orchard) in the above plan of a spiral coil, containing, as you see, only one row of trees, and the trees at a given distance apart in the row, but showing from without only a round grove of promiscuous planting, thus avoiding the stiffness of set rows. To lay this out for rows of the coil 12 feet apart, stand a hoghead of four feet diameter on the centre of the patch to be planted, wind a strong line several times around this, then with a marking stick attached to the end make a mark over the ground at the full stretch of the cord as it is unwound from the hoghead, continuing it to the full size for the grove; then plant the trees at given intervals along this line (as seen by dotted line in draft); this at twelve feet apart in the row will give about 300 trees to the acre, and I can drive a carriage into my grove, as by the small line marked into this plan, and from the centre drive six times around and out again. This stands as a beautiful ornament to the landscape and premises.

For the cedar and pine growth referred to, I gather the small seedling plants from their native bed, reset into nursery rows until sizeable for the forest growth, then treat as others. Of the second growth of native forest referred to, one has now grown about thirty years, and at twenty-five years' growth was estimated to yield 100 cords stovewood to the



acre, but for years I have cut hundreds of cords by thinning out its growth. The other is now of ten years' growth and doing well.

EXPERIENCE IN THE NEW ENGLAND STATES.

I have received the following from Mr. Fay, of Boston, well known for his successful labors* in tree-planting in the New England States. The principal method which he has followed has the merit of remarkable ease, being simply to scatter the tree seed on the ground without preparation. Owners of some of our waste lands will perhaps see their way to imitate him in this. Another idea mentioned is excellent, namely, that of removing the young pine trees scattered over a field to one small enclosure. As my readers are aware, the principal trouble in transplanting the pine and all its variety is that if the roots be dried by either sun or wind the resinous matter is apt to harden, circulation is stopped, and the tree must die. In removing from point to point in the same field, however, this need never occur :

I have made extensive plantations of forest trees, both by seed and from the nursery. A good deal of planting has been done by seed in my district (Cape Cod) and very successfully, for the greater part with pine.

My own planting, commencing some twenty-five years ago, has been from the seed to the extent of 100 acres or more. It has been done on treeless old fields and pastures, in lots mostly adjacent to each other, of ten to twenty acres each, enclosed by stone walls, with cart or cattle ways through them. Were I to plant a block or square of 100 acres, I should divide it into four parts by a blank space running through and across it of 100 feet wide so as to guard against a sweeping fire, and to give a chance of restricting its ravages to the section in which it might begin. My plantings of seed were by sowing them broadcast on the swards in March or April, perhaps on a light fall of snow, and leaving them to nature. This has been entirely successful, but they have come up too densely, requiring thinning. Some of my neighbours plant by sticking a hoe in the soil. Some by running a light furrow and dropping the seed there four or five feet apart, covering slightly if at all. This is an economy of seed but more labour, and by knowing where they were dropped one can more easily tell if the seeds germinate. My trees, planted as I have said, are now fifteen to twenty-five feet high, making quite a forest, and very thrifty, thinned out by hundreds of loads of cuttings to about seven feet apart on the average, and ought to be thinned again. The kind of seed I have used has been the native pitch pine, the white pine, and the Scotch pine, mixing some Austrian and Corsican pine and Norway spruce. But so far I have found the Scotch pine to do the best, and of that I have planted most, though I question if it will prove as valuable a wood for timber as some others. It is a fast grower, hardy and thrifty. The native pitch pine has been subject to a fungus or blight which destroys it, while the white pine is not suited to the salt air of the seashore. I have planted pine because the previous or general growth was oak and hickory, but I have no doubt that any of the hard woods would do as well. The Norway spruces have germinated and grown very well, and I should recommend them.

In the way of planting out with the spade from the nursery, I have covered many acres, probably at least fifty, in forming ornamental woods and shelters and groups, setting out many thousands of trees with eminent success. At first I imported Scotch larch, Scotch birches and sycamores, with Scotch and Austrian pines and Norway spruce from England, and planted them out in the fields or openings in older woods, about seven or ten feet apart, and now they are in twenty-five years fine trees, making at least seventy-two inches growth in diameter at the butt, and one foot high per annum. In fact the Scotch larches and birches have made three-fourths inch diameter and eighteen inches' height per annum. Some of them now fit for railroad ties. Some of the white pines in *sheltered places* have done as well. My land is poor, being drift (sand and gravel) with a

little loam, hilly and exposed to violent sea winds for the most part, yet the growth has been very good.

Of late years I have been getting larches and some other trees (twelve to fifteen inches high) from Messrs. Robert Douglas & Son, Waukegan, Illinois, which I have planted successfully. The trees are less likely to heat in the transit than in coming from England. I have obtained the red pine (common with you) (*Pinus Resinosa*), called in New England; the Norway Pine, from Michigan of late, and think that I shall find it the best, as it is the most beautiful of all the pines except the white. I am also planting the yellow or cherry birch, and the paper or canoe birch, which I get from Michigan, and I am sure that in rapid growth and in the value of the wood they will prove very desirable. One of my children planted last spring 10,000 white ash trees got of Douglas, three by three feet apart, expecting to thin them at ten feet high for poles, etc. These are planted by themselves as an investment. I have, as a rule, mixed my nursery planted trees for effect, except four or five one-acre blocks of larches, rather than with a sole view to profit, and I am making additions of various trees yearly as experiments as to climate, soil, etc.

Seed planting takes the least labour and capital, but planting trees brought from nurseries at one-fourth to one-half cent each saves two or three years of time. The trees planted seven by six feet apart, or 1,000 to the acre, are too near for a permanence, but my land is so exposed that by close planting they shelter each other till they are ten or fifteen feet high, when they ought to be thinned. They should not stand for timber nearer than ten or twelve feet apart, I should say, and then depending somewhat upon the kind of tree and its habit of growth. I have seen very good results in our State (back from the coast) by taking up the seedling (volunteer) white pines, scattered over a pasture, or by the road side, setting them in a body at regular distances on a field, and leaving them to grow. In a very few years they have been ready to cut for boards, and have paid a large profit on the labour, value of land, etc. I have never made any preparation of my land but have planted my trees, or sown my seed on the ground, and left them to nature. My seed I have procured from England or France, but they can be got of the seedsmen in Boston or New York, or of R. Douglas & Son, Waukegan, Illinois. Larch trees did not grow from the seed, broadcast, only here and there one. I suppose because the soil was poor and dry, and they could not, after germinating, resist the hot sun. The pine sometimes fails in a dry hot season, though the grass usually gives them shade enough. When raised in nurseries they require to be shaded the first year and until the hard wood forms in the second year. In my opinion nothing can be more profitable in the use of land of ordinary quality than in planting the seeds of forest trees or even in transplanting trees from the nursery or way sides to vacant spots.

Dr. H. A. Cutting, Lunenburgh, Secretary of the Department of Agriculture, Vermont, sends the following concerning sugar orchards in that State. It is time that, in Ontario, we considered whether wind-breaks of such trees, say seven or eight rows broad, along the north and sometimes the east or west sides of farms, according to exposure, would not be profitable, considering the amount of sugar which could for many years be obtained from them. In this volume many instances will be observed, giving the growth of maple trees when planted alone, but it should be remembered that, if planted in rows, say five feet from tree to tree each way, and slightly cultivated yearly, so as to keep the land mellow and free from weeds, trees will grow with almost double their rapidity. They have two advantages, the whole ground is shaded over the roots—a thing loved by the forest tree; also, in trees growing in mass, there is an emulation to overtop, which draws the whole upward. They can afterwards be thinned to any desired distance.

There have been some sugar orchards set here, and they have proved profitable. One I have in mind has been set fifty years. The trees are large and productive. Others have been set thirty years; they do to tap in from fifteen to twenty years, and from thirty to forty years from setting become very profitable.

WESTERN STATES PLANTING.

The following is from Mr. C. M. Culbertson, of Northern Illinois, describing his success in planting walnut trees. It will be noticed that, having a farm of 2,300 acres, he has grown walnut trees on ten acres which he expects will, in a short time, be worth as much as the rest of his farm; in other words, he has doubled the value of his farm. Instances like this—for this is by no means a solitary one—show distinctly how mistaken the idea that the planter of forest trees can expect no return in his own life-time. From certain instances which are narrated in other parts of this volume, the reader will find reason to believe that walnuts, for instance, will grow as well in many parts of Ontario as in the States. The soil, of course, should be suitable. The walnut would die on a poor soil which, nevertheless, would be exactly suited to the growth of pine. Mr. Culbertson does not state the nature of his soil, but in travelling through lands in his locality, it seemed to me to be generally of a rich and deep loam:

In the spring of 1855 I broke some raw prairie land in Douglas County, Illinois. In the fall of the same year I planted about ten bushels of black walnuts as they fell from the tree (with the hull on), in the manner following: I took a common shovel plow, and marked off the ground in checks ten feet apart, and planted one walnut in each check, making the planting ten feet apart each way. They all sprouted and grew. I tended the field in corn for several years. After two years the side limbs should be cut off yearly for several years. When ten years old every alternate tree should be cut out; after that keep culling out the smaller trees from year to year as they show signs of falling behind (in growth) of other trees. Keep this up till you cut out three-fourths of all you planted, when you will have a stand of trees of uniform size and vigour. You will find after about eight years' growth that no planted crop of grain will grow among the walnuts. The ground will be so shaded that it ought to be put down in grass. I have a grove of fifteen acres of black walnuts planted and managed as above set forth.

The sizes now are from about 10 to 18 inches through at axe cut. They are straight and without limbs for from twenty-five to forty-five feet from the root; some of them eighty feet to the top. I am still cutting out the weakly ones in the month of June, and peeling off the bark and piling them up and drying them, then using them for cribs, bridges, etc. My grove of walnuts are now considered very valuable, and in a few years are likely to be worth more than the balance of my farm of 2,300 acres.

The following, received from Mr. R. Douglas, the celebrated tree planter, of Waukegan, Illinois, who holds many planting contracts from railway and leading men, and has planted not merely many thousands but millions of trees throughout the Western States, will be found of interest. Soil and climate, no doubt, differ somewhat, but many valuable hints can be obtained from his methods of operation. Moreover, the States are the only place to which we can look for examples, as we have very few plantations in Canada, and European systems do not, in the instances I have had the opportunity of observing, answer here. Mr. Douglas, who, I regret to learn, is in poor health, sent two communications at different dates, but as both are valuable, they are given here. He says:

To be brief, we break the prairie in June when the grass is succulent, so that in August we can reverse the sod (not cross-plowed but plowed the lengthway of the furrow). We plow an inch or two deeper than the sod was broken, so that the ground looks mellow and nice; by the next spring this sod is so well rotted that the spade goes through it readily, so that all we have to do is to harrow the land and then mark it off with a corn marker four by four feet. A tree is planted at each cross section, so that they stand four feet apart

each way. We cultivate them same as corn, with a two-horse corn cultivator, both ways, so that we do not use a hoe, but sometimes pull a few weeds close to the trees. We like to plant trees about one foot high, so that one spadeful of earth can be lifted and put back when the tree has been placed. In this way they can be planted very fast.

In order to establish the fact that forests can be successfully planted without the aid of experts, we took three contracts. Two of these plantations are in Crawford County, Kansas. We have already planted 500 acres on these two contracts and will plant 500 more acres before the first day of May next. These trees are planted by ordinary laborers, superintended by a man who never worked a day in a nursery. They are planted with spades, and stand four by four feet apart, the ground having been marked out same as for corn. One man or boy holds trees for two planters, and the three together average 4,500 trees planted in a day of ten hours. We plant 2,720 trees to the acre; our contract calls for 2,000 trees to the acre; they stand over 2,500 to the acre. They consist of three-fifths *Catalpa Speciosa* and two-fifths *Ailanthus*. The *Catalpas* three years planted stand from six to ten feet high and two to three inches in diameter at the collar, shading the ground so as to need no further cultivation. On the richest land they shade the ground after being two years planted.

As these trees are planted by farm hands and cultivated with common corn cultivators, it proves that any farmer who can raise an acre of corn is competent to grow an acre of forest.

In order to establish the fact that the very poorest lands can be profitably planted to certain kinds of forest trees, we purchased several hundred acres of sand ridges and blowing sands on the western shore of Lake Michigan. We have succeeded with Scotch and Austrian pines on blowing sands, and white pines and European larches on sand ridges sparsely covered with a vegetation of bearberry, rotentilla and trailing juniper. These trees occupy about two years in extending their lower branches to cover the sand and then throw up leaders almost as rapidly as if growing on good land. This experiment was not made by planting a few of the difficult kinds of trees on a few acres, but by hundreds of thousands of trees on three to four hundred acres.

Aside from the above we hope to succeed with a few others. While we have succeeded beyond our expectations with the above, we must confess we are disappointed with some others. Pitch pine (*Pinus Rigida*) stands less than two feet high, while Scotch Pines, planted near by and at the same time, stand six to ten feet high.

Pines, ponderosa, red pine and table mountain pine are among the failures; also spruces, firs, arbor vitae, and red cedars. Also nuts, including black walnut, butter-nut and chestnut. Also maples and box elders, and many others. These tests were made thorough. Tens of thousands of many of the kinds were used where not one tree made a satisfactory growth.

Trees planted west of the lakes on such barrens cannot be expected to succeed so well as further east where there is more moisture in the atmosphere. Our hot winds in August and parching winds in winter are too severe for many trees that would survive in the Eastern States in the same latitude. The *Ailanthus* is hardy in 42 degrees in Massachusetts; here it will not endure the winters north of 40 degrees. Where the *Ailanthus* will endure the winter it is no doubt the most profitable tree to plant on barrens.

We have planted over 1,000 acres in Kansas alone aside from other plantations. We prepare the land same as for corn. Four by four feet apart, I think, is the best distance to plant; consequently we mark off the land same as for planting corn, and plant the trees at the intersections of the marks; we plant with spades. In that locality we think *Catalpa Speciosa*, and *Ailanthus Glandulosa* the most profitable trees to plant. Trees five years old stand fourteen to eighteen feet high, and from that down to three feet at one year's planting. We cultivate with corn cultivators till the trees shade the ground, when they need no further care till they need thinning out, where they crowd each other too much; they need no pruning, as the close planting shades and kills out the lower branches. In Upper Canada, I would recommend planting white ash, wild black cherry (*Cerasus serotina*), black walnut, (black walnuts in the southern part of the Province), yellow birch, white pine, European larch. These are among the most valuable kinds and rapid growers. The black walnut should be intermixed, say the sixth tree in every sixth row; this would make them stand

twenty-four feet apart after other kinds are removed, the white pines every third tree in every third row.

The ash, cherry, and yellow birch should stand eight by eight feet, filling in with silver maple and box elder. The two last named should be thinned out first so as to leave the black cherry, ash, yellow birch, etc., standing eight by eight feet, I would like to write more fully but dare not. All the trees named except the white pine, and larch and birch, can be planted at one year old, selected twelve to fifteen inch trees.

P.S.—Of course broken land or the sides of ravines, etc., can be planted according to circumstances, but where the land cannot be plowed, stronger trees would answer a better purpose.

The following, forwarded me by the kindness of Mr. P. C. Reynolds, gives a valuable instance of a plantation from Mr. Douglas' seedlings :—

In 1879, in pursuance of my practice since I have been the Rural Editor of the *Rural Home*, I visited a farmer in Genesee County, N.Y., named Peck. I copy for you a portion of my notes of that visit : "We came to a ten acre plantation of European larches and Scotch pines. We first entered his last planting, transplanted four years, the seedlings two years from seed. He purchased the seedlings when one year old of Douglas & Sons, of Waukegan, Ill., planted them in nursery rows one year, and then transplanted them in forest, four feet each way. A smart man will transplant 1000 a day. An acre will contain 2,640 trees. Those transplanted four years were from eight to ten feet in height, very vigorous, branching, and with trunks from one and a half to two inches in diameter at the surface of the ground. Those that had been transplanted six years were from ten to twelve feet high and more than three inches in diameter. Over to the west side some that had been transplanted eight years ranged from eighteen to twenty-four feet in height and four to six inches in diameter. Every sixteen feet, each way, a Scotch pine had been planted, and, although not as large as the larches, they had made a healthy, vigorous growth. In a very few years he can begin to thin out the larches, using them for poles and fence posts. The soil is far from fertile, being clay loam, with a shale rock near the surface."

I have given you the main points of my observations of Mr. Peck's forest plantation, which is the largest one I ever saw. I have seen small groves made up of a variety of forest trees that were flourishing.

Mr. Henry Wallace, of Des Moines, Iowa, sends the following. As will be noticed, he favors wind-breaks of seven or eight rows planted closely. There is this to be said in its favour, that the four centre rows being shaded by those outside, would probably produce valuable timber, as if, in fact, they were in a dense forest. The timber would not be so long and clear as that of the actual forest tree, but would be more tough and durable :

The groves planted throughout this region are in rows about five feet apart, trees in the row about four feet.

I am planting this spring in rows five feet apart, and three in the row, intending to remove every other row when large enough for posts. This is the way I plant all soft wood trees, as they make a magnificent wind-break, and the wind does not break them. The current of air rises on the grove and leaves a calm in the grove and leeward side.

The same practice is followed with hard wood trees, such as ash, catalpa, and black walnut. Of course trees are planted in rows along roads and around fields, but for a wind-break or shelter for stock in winter, or protection to buildings or orchards, the way is to plant eight or ten rows five or six feet apart and three or four feet in the row. The trimmings when fuel is scarce will pay well.

Mr. E. D. Porter, Professor of Agriculture, Minnesota University, gives interesting particulars concerning the effect of the timber culture laws in that State :—

During the past year I have had an opportunity of observing the result of our National

"Timber Culture Laws" in this State and Dakota, and have been very favourably impressed with the results of the work of tree planting, where it has been done with the least regard to the conditions essential to success. I find blocks of five, ten, and fifteen acres of trees dotting the prairie, now from ten to thirty feet high, where five years ago there was not even a shrub visible. I look out of my study window now and see cottonwoods sixty to seventy-five feet high and two feet in diameter, and balsams, Norway spruce and maples forty, fifty and sixty feet high, all less than thirty years old, showing what has been done by common farmers, and with the least ordinary attention.

Mr. C. W. Hall, Minneapolis, writes concerning Minnesota planting. It will be observed that the instance of pine which he considers rapid growth, is not at all as rapid as some noted in Ontario, hence it may be thought that—the proper trees chosen—our climate is the best for tree-growing :—

I have seen in a few places here and there, through the southern and western parts of our State, clumps of trees of a few years growth. They are largely set about the farm buildings, apparently as much for protection as with any view to growing a permanent timber supply for the farm. The species most noted are the cottonwood, the box-elder, and the white willow ; and I should judge, nearly in the order named, so far as quantity is concerned. Some agitation has been observed over the black-walnut and the maple—the soft maple is frequently to be seen—but I have no personal knowledge of these trees being planted in clumps. The favorite mode of planting is a row around the farm, or a convenient part of it. In all the prairie portions of the State, as far as my observation goes, all the above named trees grow rapidly, and are easily started under intelligent management.

On enquiry of Mr. M. Pearce, a nurseryman of this city, I learned that in 1827 a few acres of white pine were planted in Wabasha County, and the trees were doing remarkably well, being now fifty feet high. They were planted in the ordinary prairie soil. Mr. P. assured me the white pine and the European birch were to be the trees of the future here in Minnesota ; and that following these were the box-elder, the cottonwood, white and rock elm, ash, and sugar maple, about in the order named. The last one was very rapidly coming into favor, and would possibly outstrip some of the others.

While quoting the above valuable instances from the United States, it may be remarked that in some of them forestry has, under State auspices, been much longer studied than it has in Canada. It may be well, therefore, that, choosing places where soil and climate are not very unlike our own, we notice what trees and what methods are recommended by their State organizations, so far as they relate to trees which are known to thrive in Ontario. Some of these coming from the prairie countries will have special interest for those in our North-West and newer territories. The following are from the pamphlet issued by the State of Iowa, and I observe it largely quoted as valuable and correct by the leading forestry men throughout the United States :

WHITE WILLOW.

This tree is being extensively planted as a combined stock-barrier and wind-break—but few trees have been planted as yet in timber belts—in fact the general impression, even of the friends of the willow, is that it has little value either for fuel or any other use connected with farm improvement, aside from that for which it has been so extensively planted. In Europe, however, the White Willow is regarded as a valuable timber tree, and the time will come when it will be so regarded in the prairie States. We have become so wedded to the use of pine lumber for building purposes that the idea of using the poplars and the willow in its place, grown on our own ground, and cut up with cheap portable mills in our own yards, we are slow in acquiring—but with the coming scarcity, and advance in price of pine lumber, *we will become more teachable.*

It grows rapidly, often to the height of thirty feet in ten years, and attaining a height of over eighty feet.

Large cuttings planted in spring or fall, as with poplars, furnish the easiest method of starting the grove, or the combined wind-break and stock-barrier.

Perhaps no tree raised in the North-west will produce as many cords of wood to the acre in a given time as this, and the readiness, vigor and rapidity of growth with which it reproduces itself from the stump when the top has been cut off, as well as the adaptability of the timber to various farm uses, recommend it for extensive planting. No one of our trees will, like it, make a live fence and a fence from which you can take stakes, poles and fire-wood, without weakening the fence as a stock-barrier.

WHITE POPLAR.

This beautiful tree is usually voted a nuisance as an ornamental or shade tree, on account of its wonderful tendency for suckering.

In groves, this habit would prove no drawback to its culture—it is probable that we have no tree that will reach saw-log size as soon as this. Trees in this State are plenty, two feet in diameter, with a growth of only fifteen years. Isolated trees head low and have wide, spreading tops. In groves, it runs up tall and straight, and the poles taken out in thinning reach a size suitable for nailing on fence posts, and even for rafters and sleepers in astonishingly short time. If cut in summer and peeled, they prove durable for these purposes, where kept from the ground, and they are very strong.

It may be propagated by slips, suckers, or by branches five or six feet long and two or three inches in diameter; where the latter are used, the larger end should be sharpened by a sloping cut on one side, to expose the bark, and set fifteen or eighteen inches in the ground. The disposition of the tree to sucker would be no objection in forest culture.

We urgently recommend this tree for extended planting in outside belts, on our most exposed prairies. It will prove immensely valuable in the near future for building purposes.

WHITE PINE AND LARCH.

These well known trees are placed together, as many experiments at the West have demonstrated that they are mutual aids to each other in growth, and on the prairies we have special uses for the larch poles, when it becomes necessary to cut them to give room for the development and growth of the pines. But few of our prairie settlers realise how cheaply they can now start an acre or two of these valuable and really quick-growing conifers. Aside from intrinsic value for timber, such groves prove good investments in the way of breaking up the monotony of prairie scenery, and as places for pleasant resort for stock in winter as well as in summer.

The most profitable mode of planting is to set the plants in rows four feet apart. Every alternate row is planted exclusively with larch, three feet apart in rows. In the row in which pines are planted, they stand eight feet apart with a larch planted half way between. When the arch poles are cut, the pines stand eight feet apart both ways.

As to the kind of larch, the European has given best satisfaction in growth, but do not hesitate to plant the American variety if good plants can be obtained cheaply. Those from Wisconsin have grown as fast as European, and the poles are just as durable. Prepare the ground for planting in the fall, and put out the larch plants *just as early in spring* as the ground can be worked. They start very early and at a very low temperature, and are very apt to die or be seriously set back, if started before setting.

In handling the young pines, if the tops are clipped quite severely, they will be more certain to do well. Do not expose the roots for a single minute to air or sun. If other conifers be mixed in the plantation, it will add to the beauty of the ground. The relative value of the conifers for shelter-belts and ornamental purposes, is considered in the annual reports of the Horticultural Society, a copy of which should be in the hands of every prairie farmer.

THE ASH.

We do not hesitate to say avoid Eastern grown seeds. At the nearest place gather seeds without thought as to species, except in the case of black ash, which is distinctive and well known.

Spread out the winged seeds on a smooth, hard patch of dry ground, not more than four inches thick, cover with straw, with boards on top to keep off most of the snow and rain; sow early in spring, if possible where permanently wanted. Mark out the ground one way, as for corn, in rows four feet apart, plant four or five seeds in a hill, every two feet in the rows. A few days later plant small sweet-corn, or Yankee-corn, in the spaces between the points where the ash seeds are germinating. Start the cultivator as soon as the plants can be seen. While the plants are making a start, go through with a hoe to keep down the weeds. In a very few days the two-horse cultivator may be run as close to the ash plants as to the corn. Leave the cornstalks on the ground to hold the snow the succeeding winter. The surplus plants may be used to fill vacancies. If you call the plantation thus started White, Red or Green ash, you will soon find, with good care, that you have a young grove of which you are proud.

BLACK ASH.

Nature plants this useful tree as she does the larch, in swamps, along ravines, in moist rich bottoms, and quite rarely on rich second bottom lands. It does not prove profitable to plant it on dry ridges, nor indeed is it best to put it in full rows, in plantations running from the edge of ravines to higher land. Plant low moist patches, wherever they occur, with Black ash. On such grounds, with culture when young, this ash grows rapidly and thrifty. Plant very closely in the rows and utilize

the poles in thinning for hoops, splints, stakes, etc. With increased size the poles are strong and durable nailed on posts for fence. This ash, like all the others, is noted for vigorous sprouting from stump out in winter.

W. L. Brockman, of Carroll, Iowa, recently pulled a Black ash sprout, of one season's growth, ten feet high.

Propagate same as White ash.

BLACK CHERRY.

Contrary to usual belief, this tree grows very rapidly on our richest prairie soil. In the early plantations of timber trees, near Elgin, Illinois, a tree of this kind has a circumference of sixty inches one foot above the crown. It grew from seed planted twenty-six years ago. Trees in groves in eastern Iowa, fifteen years planted, are fully as large as Soft maple of the same age, though for the first eight years Soft maple attains the greatest diameter, but the least height. In response to request, Dr. Warder, of Ohio, sends a paper on the desirable points of this tree for culture, to which attention is directed in the Iowa Horticultural Report of 1875.

Several correspondents have admitted the value of the timber for fuel, and its probable value in the near future for manufacturing and cabinet uses; but complain that it does not come up to recommendation in durability for posts and stakes. As with the elm, larch and black walnut, if the posts are set green, this complaint is well founded; but if the bark is hewn off from the lower ends, and from two sides above, and the posts are set up for seasoning one year they become durable as post timber.

The black cherry produces an abundance of fruit while the trees are yet small. Under culture the size and quality of this fruit is much improved.

Cherries for seed may be gathered by being shaken on to sheets or blankets; to preserve them through the winter, mix thoroughly with sand, place in shallow boxes and bury slightly on north of a fence or building, or place the boxes in the cellar. In the spring they germinate at a low temperature, and must be planted early. They make trees far more rapidly if planted where wanted, as advised for the ash; they transplant well, but, as with most of our fruit trees, much is lost in health and rapidity of growth by disturbing the first tap-root. If planted in hills put three or four pits in a place and save the best plants the next spring.

BLACK WALNUT.

Each season we acquire new bits of experience as guides in the labour of tree-planting.

Careful observations during the past two years in the prairie States convince us that the black walnut makes most rapid and healthy growth on our prairies richest in humus, and yet having a porous sub-soil, so that it will not suffer in extreme seasons of wet or drought.

Another fact in relation to its growth has become apparent which will be important for planters to remember: where blue-grass has been introduced it is sure to get in and ruin or sadly injure the trees when planted alone in groves, unless culture be kept up more years than it is profitable. This special liking of the blue-grass for the black walnut groves results from the very late period in the spring when the foliage is fully expanded, giving the blue-grass such a start that it matures its seed. In Illinois this has become such a drawback in the culture of this tree that it is now being planted in alternate rows with some tree coming into leaf early in the season. Soft maple and box-elder have been used to good advantage for the alternate rows, which must be taken out in whole or in part for fuel, when it is evident that they are seriously injuring the walnuts. With this treatment the walnuts will run up faster and straighter than when planted alone, and they will be free from grass.

Judge Whiting gives this opinion as to value of timber for posts, and mode of keeping and planting nuts:

It is very durable, if put in the ground dry, for posts. Fifteen years ago I planted cedar and walnut posts at the same time, and also posts of white oak. All are now decayed about equally. Always plant the walnut where you want it; will transplant well, but loses, in losing its tap-roots, years of growth. Seven bushels of walnuts, with the shucks on, will plant an acre. During the winter I put in trenches, not too thick, and cover with leaves.

Plant before sprouting, if possible. Make the ground as for ash, and plant the nuts early and deep, so that they will not dry.

BUTTERNUTS.

This well known tree of the Northern States does well on about all our varied prairie soils, either in groves or planted singly, if in not too exposed positions. Western experience makes it certain that propagated from seed, with culture when young, the nuts may be much improved; as the shell becomes thinner, the kernel becomes larger and richer and it is much easier taken from the divisions of the shell.

When dry, the wood lasts well for posts, and the poles, when large enough to split, where they run up straight in the close plantings, are durable and strong for fence rails. The nuts are prepared for planting and are started the same as black walnut.

HONEY LOCUST.

This fine native tree has received more attention in Europe than here. It has there sported in distinct varieties, with extremely varied habits of growth. This tendency to variation is exhibited in growing its seedlings, and we even notice that our native trees are varied in time of flowering, color

of petals, habit of growth, and even in hardness of tree when grown on the prairie. Our correspondence continually indicates a common belief that this is a true locust, and that like the black locust, it is noted for sprouting and liable to the attack of the borer. We wish to repeat that it *does not sprout* any more than the maple, and that no form of insect has yet molested it, except a long-necked beetle often found on potato vines, called by Harris, *Cantharis Cinerea*. Plants in nursery and young hedges are sometimes set back by these hungry fellows at work on the foliage. The only effect, aside from a brief check in growth observed, is that the plants so treated become more thorny than those unmolested. We have experience with this timber as a fence material dating back near twenty-five years. Fence rails of that age, made from tough native timber, nailed on posts, have outlasted three sets of posts and two sets of red oak rails, and the locust rails are yet mostly good. These rails were split and nailed on in June and July. Posts made from native timber, seasoned one summer before setting, mixed with white oak posts treated in the same way, lasted equally well. Some *long* honey locust posts in this fence, when rotted off, were inverted, and lasted ten years longer in a new fence. It is well to say that young timber rapidly grown on our rich prairie soil, will in no case prove as durable as that of our old native trees. But recent observation in the groves of Illinois of twenty-five years' growth, makes the fact evident that as growth is impeded by standing *thickly* and complete occupancy of the soil by roots, the proportion of sap-wood becomes small, and the heart-wood becomes firm and dry, as noted in thick growths of the poplars. As fuel, the honey locust rates in value with the red oak.

The seed ripens in autumn, and may be gathered any time during the fall or winter; but the sooner pods are gathered after falling to the ground, the better. On most of the rivers of the State pods may be gathered in quantity grown on thornless trees.

Before planting, scald the seeds severely; part of them will swell; sift these out with a coarse fanning-mill sieve; scald the remainder again, repeatedly scalding and sifting until all are swelled. The ground should be ready and the seeds at once planted. They will come up in two or three days if the weather be favourable, and their upright growth is so rapid that less care is needed in picking out weeds from among the plants than with any other forest-tree seedlings. Keep the weeds down carefully with good culture during the summer; take up the plants in the fall and heel in carefully where water will not stand, or cover in seed-bed with a heavy mulch as soon as the ground commences to freeze. If left standing in seed-beds, the plants are often injured during the winter unless mulched. After the first year the plants are perfectly hardy, if seed from our native trees be used. Many of the plants produced from the foreign honey locust seed prove as tender in our climate as the peach tree. No valuable tree in our list bears transplanting with as little check to growth as the honey locust.

RED ELM.

If this elm be planted singly for lawn or shade trees on the prairie, its terminal branches are often covered with unsightly excrescences; but thrifty seedlings, in forestry rows, four feet apart, cultivated four or five years, will grow right along and show every sign of health and vigor. It is best, though, to plant outside rows to windward, with trees better adapted to the winter blizzards. Few realize the rapidity of growth, under culture, of this valuable tree. The writer has trees of six years' growth as large as box-elders of the same age; that is, not quite so large as the crown, but containing more timber on account of retaining size to much greater height. We have no tree with so great a proportion of heart-wood in young growths as this elm can show. In close plantations it runs up straight and tall, and when the poles are large enough for two rails they divide like the chestnut, and the rails nailed on posts are very strong and durable. At any stage of growth the poles are durable set in the ground if thoroughly dried before they are set. A very dry elm pole, set for a hop pole twelve years ago, is still standing. The red elm should be as popular as the soft maple. It grows as rapidly, is far harder, it is freer from insect ravages, it is worth far more for fuel, it is excellent for rails and even posts, its lumber is valuable for stable floors, bridge plank, waggon-hubs, and many other uses. The tree requires little, if any, care in the way of pruning, etc. If it could supplant the maple, the gain would soon be very apparent.

The seeds of the elm ripen in May; usually before the tree comes into full leaf. The seeds are light, and being surrounded by a membranous wing, they are widely scattered by the wind. Sow at once on gathering, and by all means sow where wanted, if possible. They may be planted in corn hills to excellent advantage. They usually grow to about one foot in height the first season. Planting with corn is an advantage, as the plants are sometimes injured when very young by direct exposure to our dry air and hot sun of July or August. The plants transplant readily, but if you want rapid growth, never break the first tap-root.

SOFT MAPLE.

This and the red maple are well known trees all over the prairie States where trees have been planted. It is unfortunate for our farming interests that it is so well known; a cord of its wood from young groves is worth but a trifle more than a cord of cottonwood, and it has literally no recognized value for any other use in the farm management. The older plantations demonstrate that it begins to decline in groves when about fifteen years of age, just when most of our trees of a better grade begin to make more rapid growth, and it is very liable to be broken off by strong winds.

Yet we say, plant the soft maple if it be found inconvenient to start more valuable species. When the crab-apple is in blossom is a good time to go for the seeds; plant at once in moist ground. If gathered where floating on water, all the better.

ASH-LEAVED MAPLE.

This is a tree of the far North-west, and planted in isolated positions on our bleakest prairies it yet maintains health and vigour. Its timber for fuel is far more valuable than soft maple. For other farm uses its wood has little value, unless, as in Europe, it becomes useful in cabinet work. For isolated shade trees on the prairies it has no superior, either as to perfection in health or symmetry and beauty of form. Trees suitable for this use can only be grown in thickly-planted belts where the stems are forced up straight. When transplanted where they have room, they soon form neatly rounded tops.

LIVE FENCE POSTS.

The straight trees from thick groves of box elder have a peculiar value for planting on outside or inside fence lines for posts on which to fasten barbed wires. They will outlast several sets of posts, and their beautifully rounded forms of top are objects of beauty in summer, and assist in breaking up wind-sweeps in winter.

Gather the seeds in the fall and keep under cover of boxes or boards until time for sowing, as recommended for ash seeds. Strong cuttings, put out in the fall, deeply, as recommended for the poplars, will usually make a fine growth the ensuing season.

OAKS AND HICKORIES.

If we plant acorns or hickory nuts, we hardly expect to realize anything from them in our time in the way of timber or fruit. The seedlings, as usually managed, are very slow in making an extension of top, but recent experimentation in this country seems to confirm the teaching of European foresters, that when properly managed in the nursery, these trees may be transplanted in safety, and will make a growth about equal to hard maple. In the spring, when the plants are two years old, the tap-roots are cut about eight inches below the surface with a sharp spade. This causes them to throw out lateral roots. If transplanted where wanted the succeeding spring, both the oak and the hickory will start at once into satisfactory growth. The burr oak treated in this way in Illinois, and put in grove twelve years ago, is now about the size of the hard maple planted at same time.

The plan of growing these trees, outlined in the extracts which follow, from an able report to this Society, on "Tree Grouping," by Dr. John A. Warder, of North Bend, Ohio, are worthy of careful consideration :

"You may have felt some surprise that nothing has been said about hickories, and that only the schooled oaks have been named. Here comes in the last suggestion, and one which is urged upon your attention as a very important mode of *grouping* that is presented with considerable confidence. It is based upon an observation of nature's methods, as seen in the rotation of forest species in most woodlands, and also upon some of the favorite methods of European forestry. It may be thus stated :

"In planting your cheap trees, see that you have them set out in rows of the several kinds in this manner, beginning with cottonwood : Plant a belt of three rows ; next set two or three rows of water maple or willow, and so on with alternate belts across the block where you want oaks or hickories.

"When you have a crop of acorns, plant one in the inter-spaces, between the cottonwoods of the middle row of each belt. The acorns will soon vegetate and make deep roots. For several years they will make little or no tops, but *there they are*, and there they will stay until your cottonwoods are large enough to be useful, when they should be cut down and utilized. Cut in summer and peel, if used for fencing ; cut in winter, if used for fuel. Either leave the brush upon the surface, or remove it and give the ground a good stirring with the plow. The oaks will now start up rapidly, and in a few years the maples, no longer needed to shelter them, should be moved in the intermediate belt, and the oaks, in rows, twenty or twenty-four feet apart, may be allowed ultimately to occupy the ground. If this wide space be considered too great, you may set belts or two rows of maples or willows, alternating with the three rows of cottonwood.

"The hickories may be started and managed in the same way. The intervening belt of maples or willows left after the cottonwoods are cut away, will be of great service to the hard wood trees coming on between them, and will force them up straight and less branched."

Mr. Johnson, of Burlington, finds that the natural timber growth of forty years, commands as much money *to-day* as the combined produce of tillage lands adjoining has produced in all those years.

If you insist on planting the box-elder at all, let it be the belt or the rows in which to plant the nuts and acorns, as its premature destruction for fuel will not be regretted.

In building up a grove of black walnut, a similar plan may be adopted, with this modification : Plant the nuts at the same time as the "cheap trees," and let them occupy the *middle* row of the three rows, before planted with box-elder or cottonwood. In this case it will be necessary to be watchful lest the nurses overpower them, and you may be obliged to hack down the nurses, or most of them, before they have obtained useful sizes. For want of this watchfulness, some walnuts have suffered in mixed plantations in Nebraska, where, however, many more set in a single row on the lines between fields, and exposed on both sides, have been rendered almost useless as timber trees, though large and thrifty, as they grew wide and low-branched. Nature's trimming is the best and cheapest, and it *gets done*. Man's work is expensive, and is often neglected.

In few instances only the contrary can be shown, where some devotee to his trees has even succeeded in keeping them sufficiently pruned to produce fair logs of walnuts, standing in single row. The

natural habit of the tree is to send out lateral branches, and to make a huge, round-headed, spreading top, beautiful in the landscape but unprofitable for the lumberman.

The white oak, burr oak, and our native oak of the prairie groves, which seems to be a variety of black oak, are the most valuable, perhaps, for grove culture. Our native black oak of our timber borders grows very rapidly, when it begins to run up and will attain size for poles, and even posts, grown very thickly. If dry when placed in the ground, it proves fully as durable as the two first named.

Gather the acorns in fall and keep in sand during the winter, where they will freeze. Plant early, and cover very lightly with earth, with a sprinkling of leaf-mould on top.

HARD MAPLE.

As a rule, it is best to gather small thrifty trees of this desirable lawn and avenue tree from the native timber, where they run up straight. They are not found difficult to transplant. When grown from seed, they are very slow in getting started upward. For fully three years they are low tufts, acting as though they never designed to make trees. They do not transplant easily on our light soils until they begin to shoot up. As a strict grove tree, we have, perhaps, many superior to it in all respects, yet the sugar maple groves planted twenty-five years ago, are now valuable for syrup and sugar-making.

As a tree for the lawn or roadside, there is none more symmetrical in growth and, though a slower grower when young, it makes a rapid growth as it attains age.

The seeds ripen in autumn, and they should be kept in moist sand until the time for sowing. The plants should be kept in seed-bed several years, and be well cultivated.

YELLOW AND BLACK BIRCH.

These trees thrive well in groves, or as ornamental trees in slightly sheltered positions. Gather the seed in fall, and mix with sand as advised for other seeds. Our native birch usually is full of catkins.

CHESTNUT.

This desirable tree is not hardy when young, unless it is cared for until it gets some depth of roots. It never does well when transplanted. Keep the chestnut in moist sand and plant early in spring in sheltered position where they can have good culture in the early part of the season. Cover the whole plant with prairie hay or straw the succeeding fall. When two years old mulch heavily in the fall well up the stems. After this, if the ground is not kept too clean the trees will usually stand the winters; but if mulched every fall until six years old, they will attain more growth, and bear fruit much sooner.

The following article, by Mr. Read, is very important for two reasons—it gives his experience with regard to the portions of the original forest still remaining in Ohio, and the method necessary to preserve them, which exactly coincides with my experience and observation with regard to those interspersed throughout the settled portion of Ontario. With regard to planting the willow, however, for protection of these forests, as here recommended, it must be remarked that objections are entertained, in some parts of the country, to the willow, which is believed by many to propagate insects. For a quick-growing tree, without this objection, it is probable that the silver poplar cannot be surpassed. Neither again should this be used when the land near by is to be ploughed, as it will certainly sucker. Probably the Norway maple would be, for such a purpose, our best tree. It grows with extreme rapidity, and its habit, when properly treated, of branching close to the ground, would render it exactly what is wanted to replace the protection formerly afforded by the destroyed undergrowth. But, as stated by many of our correspondents in another part of this work, when it is desired to preserve a forest, if it have not been allowed to become so overgrown with grass that the seeds cannot take root, the careful exclusion of cattle will allow the necessary undergrowth, the chief preservative of a forest, to grow. Through such a forest, it might be remarked, the seeds of the Norway maple might be scattered broadcast at the proper season, which would result in an undergrowth of very rapid progress. It will be seen that Mr. Read favors the retention of tap roots. This is a disputed question, with many on either side, and one which needs actual experiment.

HINTS FROM NATURE ON 'FOREST' CULTURE.

BY M. C. READ, HUDSON, OHIO.

The successful culture of forests requires a careful study of the mode of growth of each tree, the character of the soil best fitted for its growth, and of all the conditions tending to secure the best and most permanent results. Nature is her own best teacher, and the more carefully we follow her teachings the better will be our success. Departure from them in any important matter will tend to failure.

If the acres in Ohio, reported as covered with forests, were real forests, and could be preserved, they would probably suffice for the best agricultural results in the State. The preservation of these forests is now of first importance, and all influences which threaten their destruction should be carefully studied.

Instances are not wanting where efforts to make these forests more valuable are hastening their destruction. Some years ago the large elms which abounded in many of them were considered of no value for wood or timber, and were cut down and burned for the potash they would yield. The suggestion thus offered, of the supposed advantage of cutting out the valueless trees, was in some instances followed, by cutting out all the shrubs and poorer varieties of trees, for the purpose of favouring the growth of the more valuable ones. The result was, that the forests were opened up to the influence of the surface winds which swept the fallen leaves into the ravines and bottoms, the native grasses steadily encroached upon the forest, preventing the growth of seedling trees, forming a thick carpet of turf, almost impervious to water, while the destruction of the mosses and the removal of the leaves permitted the ground to become deeply frozen in winter, so that the influence of the forest in absorbing and retaining the rainfall was greatly impaired. The trees upon the margin gradually died out, or were overturned by the winds, until the early and complete destruction of the forest became apparent. The axe was then employed to finish the work, the sickly residue of the forest was destroyed, and the land devoted to pasturage or the plow.

A natural forest has a thick undergrowth of shrubs, mosses and herbaceous plants, which hold the fallen leaves in place, favour the absorption of moisture, keep the ground from freezing, prevent the access of winds, and secure that constant humid condition favorable to forest growth. The preservation of our forests requires that all these conditions be preserved as perfectly as possible, and the untoward influences of the adjacent deforested lands be in some way counteracted. Left to the influences of natural agencies, most of our small patches of forest will die out on the margins; the grass will intrude upon them, preventing the growth of seedlings; the wind will drive the leaves toward the interior, tear down the large trees, and slowly eat away the whole forest. Here is a fitting place for that useless hedge plant, the yellow willow. It will grow readily under the shade of other trees, and planted as a fence around these patches of forest, it will make a complete wind-break, and counteract the effect of the deforesting of the adjacent land. Such protection, and the complete exclusion of domestic animals, will save these forests from destruction. It is doubtful whether they can be saved in any other manner. Where seedlings of the desired varieties do not spring up in sufficient numbers, seeds should be planted so as to keep the surface well stocked.

This work of the preservation and perpetuation of what we now have is so important in this State, as to justly claim our chief attention. On the few farms where the timbered lands are too small, they should, if possible, be made the nucleus of the new forest, and the hedge or wind-break of willows be so located as to include within its boundaries the whole of the area devoted to forest trees.

In the new planting, an effort should be made to secure as quickly as possible the conditions under which nature secures a healthy forest growth. This can be largely secured by the thick planting of a large variety of trees. Thick planting will soon secure the requisite shading of the ground, and will resist the action of the winds. If a plantation is made of one species only, the insect enemies of that tree will probably be so increased by this artificial increase of their appropriate food as to make them formidable enemies, which

will not ordinarily be the case with a mixed plantation. In the latter case, as some will be surface, and others deep feeders, a thicker growth can be maintained without injurious interference.

But there is an error which should be carefully avoided. Most men, in planting orchards, demand trees of large size, and to meet this demand, and at the same time furnish trees that will easily bear transplanting, they have resorted to severe root-pruning and frequent transplanting to force a mass of fibrous roots. Most of our fruit trees are naturally deep feeders, pushing their roots far down into the sub-soil for moisture and mineral food. A seedling apple tree of one year's growth has a long tap-root, generally larger and longer than the growth above ground. If left to grow undisturbed, until of such a size as the fruit-grower demands, it could be transplanted with only great difficulty, and with such a mutilation of its roots as would hazard its life. The nurseryman, therefore, plucks it up after one summer's growth, cuts this tap-root into several sections, making each a stock for a graft; these planted in rich, mellow soil, throw out a mass of fibrous roots, and soon become what are called strictly first-class plants. But they are essentially unnatural products, and the weak constitutions and short lives of our fruit trees may be easily accounted for by this practice. In so important a matter as determining that some trees shall push their roots along the surface of the ground, feeding upon the rich humus exposed to atmospheric influence, and forming a broad base of interlocking roots, upon which the tree may stand, while others push their roots directly downward into the stiff, hard sub-soil, and anchoring themselves there by long tap-roots, nature makes no mistakes. It is for a purpose that these long tap-roots push themselves downwards; and that purpose is the health and vigor and long life of the tree. We fight against nature when we interfere with this tendency. The destruction of the tap-root of a hickory tree is almost as fatal as would be the destruction of all of the lateral roots of an ash. Each has its own mode of growth, and cannot be grown after the model of the other.

Most of our nut-bearing trees have this deep-rooted mode of growth. They cannot be grown in nurseries until three or four years old, and then transplanted, without such a mutilation of their roots as will greatly impair their value. If it is not convenient to plant the nuts in the places the trees are to permanently occupy, one year is as long as they should remain in the nursery. Each will then have a long tap-root and almost no lateral fibrous roots. It can be taken up with ease without any mutilation, and as easily replanted in the place it is to occupy. It will then have a natural growth, will get its food in the way nature intended it should, and, if the soil is a congenial one, will maintain a healthy and vigorous growth until it attains the stature of a perfect tree after its kind.

The mode of growth of the seedlings of all the trees we propose to plant should be carefully studied, and these deep-feeders never deprived of the instruments or members by which they seek their food. All surface feeders may be safely grown in nurseries until of good size and subjected to almost any degree of root-pruning, and, when planted out, will make a healthy growth. But if those with tap-roots are thus treated they will be comparatively worthless. If retained in the nursery, and root-pruned until the power of renewing the tap-root is lost, they will none of them make healthy, long-lived trees. If so small when transplanted that they are able to renew the tap-roots, their growth will be so checked that seedlings of one year's growth will, in a few years, surpass them in growth, and become more valuable trees.

The following statement of Mr. Foster's experience and method will be found valuable, while the article following gives an excellent and rapid method of transplanting forest tree seedlings. It should always be remembered that one of the European rules in planting is not to confine a grove to any one species. It has repeatedly been found that groves and forests planted of one kind of tree commence to decay, and that this decay was even at that late period averted by the planting of numerous trees of a different species among the original ones :

FOREST WOODLANDS,

BY HON. SUEL FOSTER, MUSCATINE.

The subject of the influence of trees in rain-fall deserves the attention of farmers. Every farm should be divided into suitable lots of five to forty acres, making divisions on the highest land for planting timber-belts. The strong, sweeping winds drive the dust from the soil, especially from the hills and ridges, and dry the moisture; and this exhaustion of water from the soil is evidently very great. Forests keep the water from running off, and prevent the sun and wind from drying the ground.

The farmer can thus readily see how he can benefit his farm by planting wind-breaks, while, if his tree-planting induces rain, the moist wind will be likely to pass it on to the adjacent or remote country beyond the reach of his patriotism. Besides the drying effect of the wind, we find the blowing of the crops about, and sometimes laying them flat, a great damage to the crop.

WHAT TREES TO GROW.

No farm is complete without a wood-lot, and it is easier to raise one than to clear off one covered with the usual natural growth. When one plants his own timber he can have such as he wants. White ash is best for farm tools; black cherry for cabinet-work. It will grow as fast as black walnut. The walnut roots, too, are poisonous to the crops and orchard trees for some distance.

Set some evergreens about the premises. They make the best wind-break. Set them on the north of the orchard and the buildings. Plant deciduous and fruit trees as early in spring as the ground can be ploughed, and evergreens a little later. Some people do not have any luck setting evergreens; it is because they do not know how. Handle them carefully. If the ground is dry use plenty of water. Keep the roots from drying from the time they are taken from the nursery till they are planted out. Plenty of wet straw or rags of gunny-sacks about the roots will keep them moist in going from nursery to the place where they are to be planted. Make a mud-hole and dip the roots in before setting. Dig the hole large enough to lay the roots out in their natural positions; fill in the earth and poke it carefully underneath all the roots. When the roots are all covered and the hole half filled with soil, dash in water enough to thoroughly settle the dirt about the roots. If it is dry, fill in more dry dirt and tramp it hard that it may be firmly pressed on every part of the roots, for the roots must have the privilege of absorbing water, and every part of the bark of the roots will absorb where the moist earth comes in contact with it.

After the trees are set, mulch or cover the surface with any sort of litter, leaving earth on them to prevent blowing away. If drought comes in summer, water; but do not slop a little water on top of the ground; it is the roots of the tree that need the water; dig the earth away until you get near the roots, then pour in water enough to wet the ground thoroughly a foot distant around and beneath the roots, then fill in the earth and cover with mulch, and it will last a long time, and usually save the life of the tree and contribute greatly towards its growth.

A few notes on the relative growth of well known species on my grounds may be useful. They are the results of actual measurement with line and pole, on March 16th, 1879:

Black cherry, transplanted from woods, 20 years' growth, height 40 feet, diameter 11 inches.

Sugar maple, transplanted from woods, 20 years' growth, height 20 feet, diameter 14½ inches.

Soft maple, transplanted, 20 years' growth, height 35 feet, diameter 16 inches.

Chestnut, from seed, 24 years' growth, height 30 to 39 feet, diameter 10 to 16½ inches.

White pine, 2 year seedlings, growth 24 years, height 50 feet, diameter 19 inches.

Norway spruce, 4 year seedlings, growth 20 years, height 34 feet, diameter 13 inches.

European larch, 1 year seedlings, growth 10 years, height 20 to 30 feet, diameter 4 to 7½ inches.

Scotch pine, 2 year seedlings, growth 20 years, height 30 feet, diameter 16 inches.

Austrian pine grows much like the Scotch, but more stocky, not quite as tall, is deeper green in colour and a more beautiful tree.

The sugar maple is a slow growing tree from seed, until it is about five years old, when it begins to make top. In the hard, grass ground by the roadside, it grows, when started, nearly as fast as the soft maple.

The black cherry grows nearly as fast as the walnut, and it is more valuable for cabinet work.

I think the white pine the best of the evergreens for timber plantations.

The Norway Spruce is a handsome tree for planting near the house.

Do not try too many species, *but be sure to set out trees and set the best.*

BEST MODE OF TRANSPLANTING FOREST TREE SEEDLINGS.

I have almost uniformly advised the planting of forest tree seeds where they are to stand permanently. But this is not always practicable, or indeed advisable. In transplanting, the plan of inserting the plants into a cavity formed by thrusting a narrow spade in the ground and pressing the handle forward, has been generally practised. But careful growers of forestry belts and hedges find that it pays bountifully to do the work more systematically. In reality, the best and surest method takes little, if any, more time and labour than the less perfect and successful mode of setting behind a spade.

Plow straight furrows four feet apart across the plot, running the plow as deep as possible. When ready to put in the plants, keep the team at hand, and deepen two or three furrows at a time, so the earth will be fresh and moist, by plowing back in each furrow with an active boy pressing down on the plow beam. This gives a deep furrow with mellow dirt thrown up on both sides. In setting the plants, two hands work to the best advantage. Stretch a line over the centre of the furrow, straighten the crooks in the furrow with a spade, and proceed to set the plants. One hand attends to wetting the roots of the plants, a bunch at a time, as taken from the convenient point where they are heeled in, and sets them upright at proper distance apart, pulling in the requisite loose dirt with his hands or feet. The other hand follows with a hoe, levelling up between the plants, and tramping the earth firmly around each plant.

Two hands in this way will soon put out several acres. After the plot is finished, cultivate with two horse corn cultivator or double shovel, depending on the height of the plants. About the middle of June, plow the spaces between the rows, by throwing the furrows towards the trees. A plantation started in this way will usually make double the growth the first year made by those planted carelessly with a spade, and if the plants are in good order, not one in two hundred will fail to grow. If plants *barely live* the first season after planting, their growth will be feeble for several years, and they are liable to perish the succeeding winter.

KEEP A GROVE NEAR THE HOUSE.

How pleasant within easy walk of your house to have a woodland of five, of ten, or, still more pleasant, of fifteen acres. Let it not be a mossy wilderness of grassy land, and old and dying timber, but a well fenced territory, where infant, half-grown, and full-grown trees, uninjured and fresh, cover the ground, clear cut of frame, tender and glowing of foliage as the bowers where Melibœus walked or Thyrsis sung. Enter for fifty steps, the world is gone; a hundred, and the solitude is utter. Without, it is the hottest

of midday suns ; but the great leaf-roof above fills every sylvan arch with cooling shade, and, passing where you will along these natural colonnades, you breathe great drafts of life-giving forest air redolent of pine and balsam. On all sides outer sound is shut from you, the distant city bells are all unheard, the nearer mill has but a watch's tick ; even the harsher noises of farming life approach the ear with muffled and not unpleasing touch.

Here is repose, for here is distraction from outer cares. Notice that the forest has a population of its own ; and if you have not been a destroying tyrant, but hospitable to the little harmless savages of the wilderness, a thousand lives will be around you, the existence of which you knew not of. In yonder hollow, now seen, now hidden, the partridge is feeding her half-grown brood ; the squirrel upon the leaning sapling beside you, glancing down with a half-friendly, half-careless air, is carving with his sharp curved teeth one of last year's nuts ; and in the insect life, on ground and fallen tree are bustling communities, colonies, monarchies, or empires, for what we know, crossing, meeting, working, assisting, as if everything hung on their efforts, you were nobody, and space were outside the fence.

Here is the home of retirement, the seat of contemplation, the birthplace of thought. He who has near him such a solitude, may rear heroes ; for the murmurings of the mighty trees roll laden with the whispers of ambition to the youthful ear ; he who has it may hope for statesmen among his sons, for the converse of such a wilderness has nurtured throughout successive ages, in many a succeeding race, in many a youthful and patriotic heart, the plans which in after days bore richest fruit of national life and national greatness.

NUMBER OF TREES required to plant an acre of land in squares, or in rows at right angles, and at equal distances apart both ways :

Feet between rows.	Number of Trees.	Feet between rows.	Number of Trees.	Feet between rows.	Number of trees.	Feet between rows.	Number of trees.
1.0	43,560	7.0	889	13.0	257	19.0	120
1.5	19,360	7.5	779	13.5	239	19.5	114
2.0	10,890	8.0	680	14.0	222	20.0	108
2.5	6,970	8.5	603	14.5	207	22.0	90
3.0	4,840	9.0	537	15.0	193	24.0	75
3.5	3,556	9.5	482	15.5	181	26.0	64
4.0	2,722	10.0	435	16.0	170	28.0	55
4.5	2,151	10.5	395	16.5	164	30.0	48
5.0	1,742	11.0	360	17.0	150	40.0	27
5.5	1,440	11.5	339	17.5	142	50.0	17
6.0	1,210	12.0	302	18.0	134	.....	.....
6.5	1,031	12.5	270	18.5	127	.....	.....

COMMON NAMES.	RECOMMENDED FOR	GATHER IN	KIND OF SEEDS.
Silver leaf maple, Soft maple.	Shelter-belt, fuel, ornament.	May, June.	Broad side-wing.
Sugar maple, Black maple.	Sugar, ornament, fuel.	Sept., Oct.	Medium side-wing.
Honey maple, Ash-leaf maple, Box-elder.	Sugar, fuel, shelter, ornament.	Oct. to March.	Narrow side-wing.
Red maple, Soft maple.	Shelter-belt, fuel, ornament.	May, June.	Small side-wing.
Sugar maple, Rock maple.	Sugar, ornament.	Sept., Oct.	Medium side-wing.
Balsam fir.	Shelter-belt, balsam, ornament.	Oct., Nov.	Nutlets in small cone.
Douglas spruce.	Shelter-belt, ornament, manufacture.	Oct., Nov.	Nutlets in small cone.
White spruce.	Shelter-belt, ornament, manufacture.	Oct., Nov.	Nutlets in larger cone.
Norway spruce.	Shelter-belt, ornament, manufacture.	Oct., Nov.	Nutlets in a large cone.
Black spruce.	Shelter-belt, ornament.	Oct., Nov.	Nutlets in a small cone.
Horse chestnut.	Shelter-belt, ornament.	September.	Nuts in fleshy envelope.
Yellow birch.	Ornament, in south half State.	Sept., Oct.	Minute winged in catkins.
Black birch.	Manufacture, ornament, shelter-belt.	Sept., Oct.	Minute winged in catkins.
Barberry (a shrub).	Fuel, ornament.	Oct., March.	Berries in racems.
Shell-bark hickory.	Hedge, ornament.	Sept., Oct.	Nut in valved shuck.
Bitter-nut hickory, Swamp hickory.	Manufacture, fuel, ornament, fruit.	Sept., Oct.	Cherries in racems.
Black cherry.	Manufacture, ornament.	Aug., Sept.	Nuts in burr.
Chestnut.	Manufacture, ornament, fruit.	Sept., Oct.	Nutlet in very small cone.
White cedar.	Ornamental manufacture.	Sept., Oct.	Double winged seed.
White ash.	Manufacture, fuel, ornament.	Sept., Oct.	Double winged seed.
Black ash.	Manufacture, fuel, ornament.	Sept., March.	Hard bean in long pod.
Honey locust.	Hedge, manufacture, fuel, ornament.	Sept., Oct.	Nut in shuck.
Butternut, White walnut.	Manufacture, fruit.	Sept., Oct.	Nut in shuck.
Walnut, Black walnut.	Manufacture, fruit.	Sept., Oct.	Berry-like cone.
Red cedar.	Shelter-belt, ornament.	Sept., March.	Nutlet in small cone.
Tyrolse larch, European larch.	Manufacture, shelter-belt, ornament.	Sept., Oct.	Nutlet in smaller cone.
Tamarac, American larch.	Manufacture, shelter-belt, ornament.	Sept., Oct.	Nutlets in long cone.
White pine.	Manufacture, shelter-belt, ornament.	Sept., Oct.	Nutlets in smaller cone.
Scotch pine.	Manufacture, shelter-belt, ornament.	Sept., Oct.	Nutlets in smaller cone.
Austrian pine.	Manufacture, shelter-belt, ornament.	Sept., Oct.	Nutlets in smaller cone.
Lombardy poplar.	Hedge, shelter-belt.	No seed.	
White poplar, Silver leaf poplar.	Shelter-belt.	June.	Minute in cotton.
Sycamore.	Manufacture, wet land.	Oct., March.	In a ball.
Red oak.	Manufacture, ornament, fuel.	Sept., Oct.	Acorn.
Basswood.	Shelter-belt, honey.	Sept., Oct.	Nutlet attached to bract.
White oak.	Manufacture, ornament, fuel.	Sept., Oct.	Acorn.
White elm, Water elm.	Manufacture, fuel, shelter-belt, ornament.	May, June.	Winged disk.
Slippery elm, Red elm.	Manufacture, fuel, shelter-belt, ornament.	May, June.	Winged disk.
Rock elm.	Manufacture, fuel, belts.	May, June.	Winged disk.

CANADIAN WOODS USED IN MANUFACTURE.

The following statements from leading manufacturing firms of Ontario will give an excellent idea of the valuable purposes served by our Canadian woods. The frequent allusions made in these letters to the rapidly approaching or even the present scarcity of which the writers speak, may do something towards inducing those of our farmers who still possess some portions of woodland, to preserve it in forest rather than give it over to the rapid destruction of the axe, or the slower but in time equally destructive method of allowing free entrance to cattle. A passage in one of these letters is particularly suggestive, where one of the writers remarks, "that a farm covered with second growth hickory from six inches upwards, would be as valuable as some whole townships that are now struggling under crops."

The following is from a prominent agricultural implement manufacturing company in Toronto :—

We use annually about one million feet of the following kinds of lumber, all of which is used in the construction of reapers, mowers, self-binding harvesters and horse hay rakes :

White ash,	principally from the Counties of Kent, Essex and Elgin.
Red oak,	" " " Essex, Grey and Bruce.
Hickory,	" " " Lambton, Kent and Essex.
Hard Maple,	" " " Grey and Bruce, but
Rock Elm,	" " " Some from all Counties west of Toronto.
Basswood,	" " " " " "

Pine (for boxes, &c.) usually bought from city dealers, but presumed comes mostly from the northern counties.

We use some second growth hickory. Sizes preferred for this are butts six to nine inches in diameter. We cannot say anything as to age. We do not use any foreign woods, and could suggest none that is more suitable for our work than native timber.

Speaking of woods used for particular portions, where strength is needed as for frames binders, etc., we use ash or maple ; spokes, hickory or oak ; for large broad ones, white ash ; for parts of binders, etc., where lightness and no great strength is needed, basswood and pine ; horse-rake axles, maple ; posts, ash ; double-trees and whiffletrees, hickory ; tongues and neck-yokes, white ash ; felloes, generally rock elm.

From a steam-bending factory at Norwood :—

We use in our business here about 3,000 logs of rock elm, and 1,000 logs white and black oak, yearly, size from nine to twenty-four inches ; we also use second growth elm for buggy and carriage hubs, about 18,000 feet per year, ranging in size from four to ten inches ; also about 500 logs of water elm, average size eighteen inches.

Rock elm we use for cutter-runners, binders and shafts ; oak for sleigh runners and waggon hubs ; second growth elm for carriage and buggy hubs ; water or soft elm for cutter reaves, arm pieces and toboggans.

The following is from an extensive planing mill in Toronto :—

We obtain timber from :—Pine, from the north shore of Lake Huron ; white oak, from Amherstburg ; red oak, from Oro, Tiny, Tay and Vespra ; butternut, a little from Western Ontario ; cherry, from Grey and Bruce ; white ash, from the same section on the C. S. R. R., as white oak ; black ash, from almost all points excepting Muskoka, especially where best red oak is to be got ; cedar, best from Northern R. R. ; hemlock, large quantities from vicinity of Barrie ; birch, largest quantities come from the same points as the cherry ; soft elm, chiefly obtainable from same sections as the cedar ; rock elm, from sections where birch is obtainable ; red cedar, from Florida ; not cut in Canada, but can

be procured on Georgian Bay Islands. We use white oak for door-sills, chancels, pews, pulpits, in fact, all ornamental church work. It would be of much more general use but for its scarcity. Much that has come lately into market as white oak, is but a kind of grey of inferior quality. White and black ash, and chestnut, for wainscotting, architraves and general internal finishing of first-class houses. Cedar, great quantities used as scantling, where there is danger of rotting, and for lining of wardrobes. Red oak, church and other doors. Cherry, walnut and butternut, largely used in bank and office fittings, also in finely finished houses for doors, blinds, wainscotting, etc. Birch is superseding cherry for bannisters, newels, rails and office fixtures.

The next is from a large agricultural implement firm at Oshawa :—

In our business we use white pine, some basswood, maple, oak, ash, and rock elm.

So far they have all been of Canadian growth ; cannot say whether any of them are second growth or not. We do not use any timber of foreign growth, but buy, exclusively, Canadian timber.

From a similar firm in Brampton :—

The kind of woods we use is all of Canadian growth, white pine, which of late years, we have procured from the north, from Georgian Bay east to Midland ; white oak and red oak from the County of Peel west to Windsor ; white ash and hickory in the same territory ; basswood and rock elm from the County of Peel north, mostly of original growth. The kind of work the above timber is used for is the manufacture of agricultural implements, viz. : threshing machines, reapers, mowers, hay rakes, straw cutters, etc. The size of timber generally used for these purposes will range from one to three feet in diameter. I omitted to mention hard maple, which we procure from all points of the compass. We also use some black birch, which we get from the northern part of Ontario, from the County of Peel to Georgian Bay. I may say we use no foreign woods.

From another of the same class at Patterson, Ont. :—

We beg to say that white and yellow oak, white ash, hard maple, rock elm, basswood, and pine are the principal varieties. These are natives and are getting scarce in this vicinity. We now find it necessary to reach out to those sections of the Province traversed by the Canada Southern Grand Trunk, Hamilton and North-western and Northern railways for our supplies.

Wood taken from medium-sized trees preferred. Second growth is difficult to get. In ash it commands a high price.

All kinds of hard wood are becoming scarce, and in a few years, at the present rate of consumption, will have to be obtained from without the Province. In fact we are even now trying to substitute wrought iron and steel in many parts of our machines, for wood.

From a well-known carriage works firm at Gananoque :—

It is with great difficulty we get such timber as we require. We use a quantity of oak, hickory—(second growth ; when we can get it, should use nothing but second growth), ash—(second growth);—basswood and whitewood. Our basswood we get locally, also oak, but hickory is from Ohio, and some from western Canada. Whitewood from the States ; ash, some local and some from the west. The second growth hickory could be grown profitably, I think, in this country. Can be used from trees from 6 inch diameter. It is worth about \$100 per thousand in the plank. A farm covered with second growth hickory from 6 inches up would be as valuable as some whole townships that are now struggling under crops.

From a leading car company at London :—

In ordinary car building the principal woods used are oak, ash, chestnut, walnut, whitewood, Southern pine, Norway or red pine and white pine, but in the fine coaches mahogany and other fancy woods are now being used. Oak, both white and red, are Canadian timber ; grows in all parts of Ontario. I think the bulk of growing oak at the present time is in the County of Essex and adjoining counties. Ash, both white and black,

more or less all through Ontario; walnut, very little good left, grows chiefly in the counties bordering Lake Erie, but is now imported from Indiana. Whitewood very scarce now and is imported chiefly from the United States. Norway or red pine grows chiefly in northern Ontario; great quantities having been cut in the neighbourhood of Stayner, Angus, Elmvale, and other places. White pine grows in the Georgian Bay district, the Ottawa district and Muskoka, Canada is almost clear of walnut, and nothing would pay farmers better than growing walnut trees.

As regards the general use of woods in car building, white oak in box cars is used as sills and stringers, that is the two outsides, and two centre pieces, are oak, and two intermediates are red or Norway pine, forming the foundation, or bottom of the car lengthwise. Oak is also used in the framework of car bodies, as studs, braces and rafters, or top frame of car. The woodwork of car trucks is made of oak. White ash is used principally in passenger and street cars. It is used in making doors, rafters and some of the lighter work of the car. Whitewood is used chiefly in passenger and street cars as outside panels and some of the lighter furnishings. Bird's-eye maple and walnut are used as inside panels, mouldings, and inside finishings generally. Southern pine is used as longitudinals in passenger cars, taking the place of oak. The body of box cars is covered (or sheeted) with the best quality of white pine; the flooring is composed generally of Norway pine. The floorings of passenger cars are generally made of oak or Southern pine. Everything in car building has to be well finished, closely and firmly put together. I may say that cherry, chestnut, and butternut are sometimes used in cars, taking the place of walnut, as they are not so expensive, and will give a good appearance to the inside of a car.

The following is from a leading carriage factory in Toronto. It is especially valuable as shewing the sizes of wood required, and the time of cutting it:

Forest ash is the wood generally used in the construction of carriage bodies, and should be cut in planks varying in thickness from one and a quarter to five inches; that is to say, $1\frac{1}{4}$, $1\frac{1}{2}$, 2 in. $2\frac{1}{4}$, $2\frac{1}{2}$, 3 in. $3\frac{1}{2}$, 4 in. $4\frac{1}{2}$ 5 inch. Very little of the last mentioned size is used. For carriage gears and poles a second growth or a first-class quality of white ash is used, and is required in planks $1\frac{1}{2}$, 2, $2\frac{1}{2}$ and 3 inches thick. Second growth and forest hickory are also used in parts of carriages and waggons. This lumber is found most convenient when cut $1\frac{1}{4}$, $1\frac{1}{2}$ and 2 in. Forest hickory is sometimes required as large as $2\frac{1}{4}$ and $2\frac{1}{2}$ inches thick. Oak and rock elm are used in buggy and waggon shops. Oak is seldom called for less in thickness than two inches, and is very often required four inches thick. Elm 1, $1\frac{1}{4}$, $2\frac{1}{2}$ and 2 inches. All the above mentioned timbers should not be cut down earlier in the fall than the first of November, and not later than the latter part of January. The logs should be taken to a mill and cut up as early as possible after the trees are cut down.

Basswood and whitewood are the woods generally used for carriage body panels. The former should be cut in boards half and one inch thick; the latter is required in thickness from half inch up to three inches; half, one inch, two and three inches. It does not make much difference what season of the year the trees are cut down, but basswood especially should not be allowed to lie in the log longer than can be possibly avoided before being cut up into lumber.

From a well-known carriage builder in Markham Township:—

Of the kinds of timber used in our line of business, first is the white oak, which is of original growth here, and is used for waggons, and cut from ten inches to two and three feet in diameter. Markham was once noted for good white oak, but it is getting culled out. There is quite a lot of red oak, but it is not so good for our purpose as white. It is porous and open grained, rotting soon. Next is second growth white ash. It is native here, makes good waggon tongues, is used in carriage building, and is cut from ten to twenty inches in diameter. Next is black ash. It is inferior to the white ash and is used chiefly in bodies for buggies and light work. It is cut here from twelve inches to two feet in diameter, and not worth so much per thousand feet as white ash is. Next is rock elm, which is a very useful wood with us here, being very tough. It answers well in waggon

and carriage work. Next is hard maple, which is used chiefly in waggon axles. It is a very stiff wood, does not spring like hickory or ash, and is cut from eighteen inches to two feet in diameter. Next is basswood, a wood that grows here and is used in bodies for buggies and in waggon boxes. It is a very light wood, is cut from twelve inches to two feet in diameter, and is also used for flooring and sheeting in houses. Next in value in our trade is shell bark hickory. This wood we have to import. It is a very tough wood, is very valuable in our business, and is used in rims and shafts for buggies, light poles, etc. Next is birch and ironwood, which are used to some extent, but not so much as those mentioned above. In conclusion I might say all of the kinds of woods mentioned in this letter grow here in Markham township except the hickory, and I believe hickory would grow here as well as any other wood. I have twelve hard maples set out. They are growing splendidly. Not one died though it was prophesied they would, as people said they ought to have been soft maple. If the Government can throw out any inducement to get the farming community to plant out trees for future use, it would be a great boon to the country and community at large, as woods are getting scarce and dearer; so the sooner they commence planting out the better for all.

With the increasing wants of civilization, new uses for timber are being continually discovered. A few years ago elevators were as rare as they are now common. The following is from an elevator manufacturer in Toronto:—

I use pine for framework and the ordinary sheeting in of the hoistways. The frame timber is better when cut from logs of sufficient size to allow of say eight by eight inch timbers being cut without the heart.

For the runners or slides I use black birch; that cut from large trees suits best for this purpose. White ash, oak, rock elm, and maple for the frame work of cars and platforms. Second growth suits better for this purpose. For panelling I use maple, black walnut, cherry, butternut, chestnut, birch, white and black ash, white and red oak, and sometimes pine. Either growth will do for this work. All these woods, excepting black walnut, are common to all sections of these Provinces. The black walnut grows in Western Ontario.

The growth of the manufacture in all the branches of wooden wares has increased the value of all hard timbers, so that instead of cutting it to waste, owners of land will find it to their profit to take care of their timber.

Cherry and birch are becoming valuable timbers and will be, of all the Canadian woods, the most likely to take the place of the foreign.

From an Orillia barrel factory:—

I may state that I use oak, elm, ash, and basswood in my business, which is that of preparing material for both slack and tight barrel work, principally flour barrels. The timber is original. Any size of trees from six inches to sixty inches are used. Second growth timber would not do, as it is too tough.

From a match factory firm at Buckingham:—

The wood used in our business, matches, is pine, and the very best at that. My stock I obtain in this section of the country, Ottawa. Much that I use is the buttings from three inch deal, the piece that is cut from the deal to bring it to length. When the supply of that kind of stock is not sufficient I use the deal. Of course you know that deal is cut from the best and largest logs. Lumber that I use for my cases is largely spruce, as that is cheaper and I think makes a tougher case, although sometimes I use pine.

From a grain cradle factory at Mount Forest:—

I get my supply in this neighborhood, but find it getting scarce and require to go some distance now to get the required quality. The timber I use for snaiths is elm. I prefer white ash, but it is not to be had in this vicinity, only in very small quantities. For fingers I use maple, natural crook. That also is getting very difficult to get. The size of elm trees should be from six to fifteen inches in diameter; maple any size. I might say all kinds of merchantable timber, such as pine, rock elm, cherry, and basswood are scarce.

Of maple and hemlock there is a fair supply in this neighborhood, that is within a radius of about six miles. Of course, in the immediate neighborhood, there is little or no timber to be bought, the farmers requiring all they have for their own use.

From the veneer factory at Harriston :—

We use mostly soft and rock elm, also birch, which after cutting into proper lengths and steaming, we cut up into veneering and barrel staves and cheese box material. We also use basswood for manufacturing into barrel heading and tops and bottoms of cheese boxes. All the timber used in the factory is grown in this township (Minto), of which there is still a good supply. It is of original growth and mostly large timber, from twenty-two inches up to four and five feet in diameter, the soft elm especially attaining good size. We use no foreign timber of any kind.

From a prominent piano manufacturing firm in Guelph :—

We give herein a list and description of the wood used by us in our business, as piano manufacturers. Black ash of the largest size and best quality, used for tops and rims of pianos, to be veneered with rosewood. Basswood and whitewood of the largest size, and best quality, carved into legs and lyres for pianos. Pine of the best and softest quality, (white), for keys, and also for bottoms and blocks used in building cases. We also use cherry for upright piano cases, and small parts of all pianos, this of the best quality. The foreign wood used is spruce, (American), for sounding boards, and rosewood veneer. We have found our Canadian spruce too hard and gummy in its nature to answer our purpose. It does not give to the piano that sound which the American wood does, and is much more difficult to work. You see all the wood we use requires to be of the largest size and best quality ; soft grain, not liable to warp or twist, and easily worked. Cherry veneer could be used, but there are no mills in Canada that can cut veneer ; we get cherry veneer from New York, yet most of our best Canadian cherry lumber goes into the American market.

The following is from a leading furniture factory in Toronto :—

Concerning the kinds of Canadian wood we use in the manufacture of furniture in our business, I will class them according to their respective value. First, black walnut, which is principally used in the better class of furniture, grows in the western part of Canada, especially in the counties of Essex, Kent, Elgin, Norfolk, Lambton and Middlesex. In all these sections the walnut has become nearly exhausted, and if there is not an effort made in planting this valuable wood, it will not take many years to become extinct for commercial purposes. The price we pay for first-class walnut is from \$80 to \$100 per thousand. Cherry is another wood that is used for the better class of furniture. It grows generally all over Ontario, more or less, and is becoming very scarce, owing to the demand for it in the United States, where most of it has gone. Its market value is from \$40 to \$50 per thousand. Oak is used by us, but not very extensively, it not being always very suitable for furniture. Value about \$30. White pine is much required in our business, but it needs no comment from me, as no doubt you are well acquainted with that class. Hard maple, or sugar maple as it is sometimes called, grows extensively throughout the whole of Canada. From it we make our inferior class of furniture, such as chairs, bedsteads, etc. Value about \$16. Rock and soft elm are getting to be very much used for a certain class of furniture, because it is so easily worked. It is cheap and abundant. Price, about \$12 to \$14 per thousand. Soft maple and whitewood are woods that we handle a large quantity of, especially the maple. These grow luxuriantly in the western part of Ontario, and are always found abundant where there is walnut. Their price per thousand is from \$16 to \$18. Butternut is also used in cabinet-making. It grows generally all over the Province, is not very abundant, and is getting scarce. Price, from \$25 to \$30 per thousand. White and black ash are valuable woods for our business, and very much used. They grow generally all over the Province in large quantities, especially the black ash, which has a very beautiful grain. Its price ranges from \$18 to \$25 per thousand. Basswood also is in much use in our manufactory, and is from \$14 to \$16 per thousand. Original growth and old trees we prefer for our business, as they are better adapted and easier worked. Second

growth is better for bending purposes. Of it we use a little, but it is more adapted for waggon and carriage making.

Some further details of the uses of woods in furniture, may be interesting. For instance, chair and table legs are made of maple or birch, those of the better class of tables, of walnut ; the curved portions of chairs, such as arms and backs, of rock and soft elm. Seats formerly made of basswood are now water elm, except those of rocking-chairs, which are still basswood. All visible portions of first-class tables are generally made of one wood, such as walnut or cherry. The inside machinery of extension tables, as of other furniture, where great strength and freedom of movement is required, is of white ash. Swamp elm is largely used for the tops and sides of tables, the legs being generally maple. Wash-stands, visible portions, of soft elm, concealed ones of pine or basswood. In bedsteads displaying the large smooth boards which are now fashionable, walnut, ash, red oak, and water elm are used, the upright portions being often maple, ash or walnut. Sideboards and ward-robres are made of cherry, red oak, water elm or walnut. Some of these woods are used for such purposes, veneered with more showy ones, frequently of foreign importation. In common chairs, cheap tables and bedsteads, the woods generally used are basswood, white-wood and water elm.

The next is from a similar firm in Belleville :—

The descriptions of Canadian woods used in my business, are black ash, black birch, cherry, soft and hard maple (beech is also used for chair work), grey or swamp elm ; this last, of late, is coming into extensive use, and has a beautiful grain, and makes a fine cheerful finish. The objection which formerly prevailed against elm was the difficulty of drying it to keep straight, which is now entirely overcome. Basswood is largely used ; our black walnut nearly all comes from Indiana. All the other kinds named are native woods, and except some basswood and some ash, are all of original growth, in fact the two latter, in my mind, are the only ones which would reach a size fit for use in less than about seventy years. From casual observation, basswood will grow to a diameter of from ten to thirteen inches in from seventeen to twenty-five years in favourable ground. Soft maple is very useful, but comparatively scarce. Birch is next in value to cherry, which is next in price to black walnut. Cherry is not abundant in this section, but birch is found in abundance just north of us, and is yearly increasing in demand.

Though scant of space I am persuaded to give my readers the following well written little essay by Mr. J. B. Smith, a gentleman connected with one of our principal Toronto lumber firms. It is a mass of valuable information, and comes from a thoroughly practical man :

The reckless waste of woods which has been going on for years, must eventually find an end in the total destruction of the timber with which this Canada of ours was once so bountifully endowed. The losses incidental to the getting out of logs have been partially estimated, but the consequential damages, such as the changes in the climate, water supply and others, cannot be computed. Let any Canadian of middle age recall the appearance presented by the forest in the days of his youth, and compare that with the present. He will remember the immense monarchs of the forest that stood towering in their rugged strength. "The Monarch Oak, the patriarch of trees ;" the wide spreading beech, the ash, Venus of the forest, with the feathery lightness of its foliage ; the noble elm, the butter-nut, hickory, and the birch, with others, many of which have disappeared. And what will our Canadian now see? No well guarded young trees replacing those which fell before the unrelenting woodman's axe, but dwarfed specimens of unhealthy progeny, or the fast decaying stump, a memento of departed greatness. Our duty is clear, not to mourn over the past wanton waste, but to be up and doing, providing for the reproduction of woods each year becoming more scarce. Reproducing is our sole recourse. This cannot be too strongly urged upon our farmers. We know what description of timber grew in certain localities, why not replant? In some counties walnut, whitewood, white ash, etc., were to be had in abundance. Now few of these trees are to be found. Necessary information can be obtained and furnished to all wishing to engage in arboriculture. Few of the trees

of our forests but have been manufactured into lumber and placed on the market. They are all used in the many industries—ash (white and black), birch, beech, basswood, butternut, balm of Gilead, cherry, cedar, chestnut, rock and soft elm, hickory, hemlock, hard and soft maple, red and white oak, pine, tamarac, spruce, sycamore, walnut and whitewood.

In agricultural implements, including waggons, are used white ash, oak, maple and rock elm.

Buildings—pine, hemlock, maple, oak, black ash, elm, birch, butternut, cherry and chestnut.

Boats—pine, oak, spruce, tamarac and cedar.

For cabinet work—birch, soft elm, maple, cherry, walnut, butternut, oak, black ash, basswood, etc.

Car building—oak, pine, cherry, birch, maple, tamarac, walnut and whitewood.

Pianos and organs—walnut, whitewood, basswood, pine, chestnut, cherry, oak.

Tool handles—birch, maple, etc.

And a host of minor industries all contribute to consume the products of our forests.

We are not content with our native woods, but go to far off climes for lignum vitæ, boxwood, mahogany, rosewood, baywood, tulip wood, holly, etc. These we cannot produce. The average diameter of trees manufactured into lumber is from 18 to 24 inches; this includes all the above mentioned kinds. These are, in the close grained woods, mostly the original; of a few they cut up the second growth.

The different species I have enumerated are to be found pretty evenly distributed. Walnut, whitewood, ash, maple, hard and soft elm, oak, balm, hickory, chestnut, sycamore, pine, basswood, cherry, are to be had in greater or less quantities in the south-western counties. For birch, rock elm, beech, maple, basswood, poplar, pine, hemlock, tamarac, we go to the northern and north-western, as well as the eastern counties. Black ash is at present a plentiful wood and can be obtained in almost any part of the Province. Soft elm is abundant, but even with our present plentiful supply, it will not long stand the demands made by American dealers, who, taking none but the largest and choicest trees, use quantities of this and other timber in manufacturing staves. Each year sees a diminished quantity of hemlock. Our supply of bark for tanning will soon be exhausted. Cherry is very scarce; what we have is a poor quality. The demand for this wood during the past year has almost exhausted our supply. In the process of ebonizing, so much in vogue, great quantities of cherry are used. White ash, butternut, and white oak, are also becoming woods of the past. Of walnut very little is to be had, and that is cut from partially rotten logs, which, when it was more plentiful, were cut, and, not being considered sufficiently good, allowed to decay. We rioted in the abundance of our forest wealth and are now suffering somewhat of the evils attendant on such a course. To-day we import whitewood and walnut from places to which formerly we exported large quantities of the same timber, much superior to what they are now bringing in.

We find the difficulty of getting a good quality of white oak, white ash and cherry increasing each year.

We are certainly opening up and clearing the country, but at a terrible cost.

In fine, unless we at once begin to reproduce, the limit of our forest wealth will soon be reached. It is not inexhaustible. Fires, cattle, and men, not lumbermen alone, but campers, hunters, etc., seem combined to destroy the remnant of what seemed an endless supply, as well as to prevent the growth of young timber.

As to the prices of Canadian woods, it is difficult to give you, as prices differ so much, they being regulated principally by the general run of the stock under negotiation, and the average quality of stock in different parts of the Province are not at all alike. However, I will give you the prices we would pay for the different kinds, loaded on cars at point of shipment, per thousand feet: cherry, \$35 to \$40; butternut, \$30 to \$35; chestnut, \$19 to \$21; white oak and white ash, \$18 to \$20; red oak and black ash, \$12 to \$14; soft elm, \$8 to \$9; rock elm, \$10 to \$11; whitewood, \$19 to \$20; basswood, \$11 to \$12; sycamore, \$12 to \$13.

Above prices are for first and second quality, together to average not less than fifty per cent. of first. Cull cherry and butternut is worth about \$14. Culls in the other woods would be worth about one-half the above prices. Pine is generally bought mill run, with

mill culls out, and is worth from \$10 to \$14, according to the percentage of clear lumber in the stock. Mill culls are worth \$5 per thousand feet. Hemlock bill-tuff is worth (up to sixteen feet long) \$7, and an advance of fifty cents per thousand for every two feet over that length up to say twenty-two feet; over that length it is worth considerable more.

DESIRABLE TREES TO PLANT.

It was the original intention to give here a full chapter on the best method of planting with a view to appearance, but want of space forbids. A few suggestions may be, however, given. We should consider to what trees our soil and climate is adapted. A tree of any variety, flourishing well, and throwing out branch and leaf in their season with strong and hardy life, looks better than another, however high its name in the catalogue, which struggling only keeps existence, and never arrives at the fulness it attains elsewhere. Then, another point, wonderfully neglected in setting out trees, is colour. If you look abroad throughout the wonderful variety which nature offers here, you will see foliage of a pure cream colour—of bright silver hue—of an infinite number of greens—of bright gold—of delicate brown—of rich crimson, and many more. We should notice what they are at the four seasons; we should also remember the height of the trees; that some can shew well above those adjacent; and that some colours are ever most beautiful when set off by certain others. It is not as if our climate were unpropitious; on the contrary, trees of endless variety of form—of infinite charms of colour—flourish luxuriantly here. And we shall find that if we take advantage of the variety, and plant with a remembrance of the effect one tree has near another, that we shall soon have charming pictures; and shall also have supplied a background of foliage which, seen from another point, will itself form a picture equally charming. Our trees—whether plantation, wind-break, or clump—will consist of varieties sufficiently near for pleasing comparison and advantageous contrast, yet not in that general jumble of undistinguishable foliage which renders the eye careless, till it passes trees as pebbles in a walk. And how easily and cheaply improvable are our surroundings. I visited lately two farm-houses. Opposite each ran the same high bank—in both farms almost useless land. But in one case it was a barren hill seared with dry water gullies. In the other it had been ten years planted, and now a beautiful growth of trees—so placed as to display in each its particular beauty—crowned the summit and came half way down the slope; the lower slope had clumps of shrubs, cared for and in luxuriant growth. The difference—the superiority of the last residence, from this little piece of forest work alone—forced itself on the least cultivated, and was indescribable. Yet the cost had been very trifling. In Ontario, nature offers us, in trees, what colour, what form, we choose of a thousand kinds. Of this great choice we have but to take advantage, to render our farms shortly as beautiful as the utter deprivation of the forest has made many of them hideous.

It may be suggested, in choosing trees with reference to beauty, either alone or in contrast, that the manner in which the different varieties reflect the light, and the kinds and lines of shadow produced, should be thought of. If we look at a Lombardy poplar we shall find that the lines of light and shade are upright and narrow. Then take a beech, the tree is in stratas; the light and shade in large level flakes. The white oak is again different from either; its fewer and larger branches radiating irregularly from the great trunk give large, uneven, but more grand and picturesque masses of shadow, and brightness than those of any other tree. The cedars often grow so close branched that their shadows are but one. The maple has numerous openings for shade and sun, but they are too many, too small, and too regular to do more than assist the general effect of the tree. If we examine foliage critically, we shall find a thousand differences to aid our selection, and one view of nature is worth many of books, for trees differ with localities, and the observer can soon find for himself how they appear where he desires to plant.

We generally plant that trees may be seen from a given point. If this central point be the house, the views of the house from the road, and towards the road from the house, are the chief vistas to leave open, not in straight rows of trees, but that, of the curving lines of plantation edge, of grove, clump, or single tree, none shall stand in the way of the view you desire, while, as the eye glances along the opening it shall observe trees on either side in graceful harmony or appropriate contrast.

Without attempting an extended list, it may be said that of those in reach of all, for planting in the open, the oak (white and red) should be mentioned. When in leaf, the masses of its foliage reflect the lights and shadows as do few others. Before planting, with all trees it is well to observe the effect of this, and consider which you would choose in contrast. It grows a large and handsome tree, with a peculiar appearance of solidity and strength in the trunk and branches, and will thrive on poor soil. It is said that trees influence character. One can imagine that the dully walk along an avenue of fine oaks—their firm position—their rigid branches defying the storm—the steel-like and martial flash of their unbending and hard-edged leaves—might possibly arouse thoughts which would have some such effect.

"To convey by words alone," it is said, "an idea of the grand and varied expression of full-grown oaks would be a task as difficult as to impart the awful sense of sublimity inspired by rolling thunder."

"Jove's own tree
That holds the woods in awful sovereignty."—*Virgil*.

The beech.—Some object to this, as being likely to die out. In those cases when I have known it do so, it had been transplanted from the shade to the sun, which had beat on its bark. The forest bark is tender. (This can be shaded by a V board). But I have generally known it to do well, and it has this peculiarity—its habit is often to branch in sections above one another, giving broad level flakes of light green foliage across the whole tree, which, swayed by the breeze, give an admirable and ever-changing effect.

Its roots run close under, and sometimes lift themselves near the trunk, above the ground.

"There at the foot of yonder nodding beech,
That wreathes its old fantastic roots so high."—*Grey*.

The elm.—Nothing can exceed, in graceful appearance, the lofty urn-like form of this remarkable tree. The beautiful curves of the branches into which the trunk, near the ground, divides, and which each then seems to form an independent tree, rising high by itself, then uniting with the rest in an immense spreading head, give this peculiar form. It should be remembered that where beauty is the object, trees which naturally grow as these should be given space to follow out their habit. Some pruning, when small, will greatly assist. For avenues, these trees need eighty feet between the rows.

"Of all trees," says Beecher, "no other unites in the same degree, majesty and beauty, grace and grandeur, as the American elm. Take them away, and who would know the land? Villages that coquette with beauty through green leaves would shine white and ghostly as sepulchres." The witch elm should be mentioned. It is more square in form and massy in foliage—equals in size the large oaks, and is one of the noblest of park trees.

"Harp of the North, that mouldering long hast hung,
On the witch elm that shades Saint Fillan's spring."

The ash is also a very beautiful tree, and, above others, sways gracefully in the wind. Its bark, too, in its many channelings, is very handsome. In our climate, with the long winter, the appearance of trees when destitute of their leaves is an important point. Trunk and branches, for long periods, are visible here. I have been where, of a summer afternoon, too warm for exercise, too bright for sleep, the long line of waving ashen foliage, from window to park gate, seemed, in the incessant change and continuous rush and play of its heavy leaf wreaths in the breeze, to arouse such succession of thoughts as passed the hours as pleasingly as might an agreeable book, or lively companion.

The nut trees—hickory, chestnut, walnut, and butternut—will, with care, all thrive and look well in many parts of our provinces. The length of leaves of the two latter give them a flowing grace so unique as to demand consideration in planting. Between their and ordinary foliage is a difference, not so great as that between evergreen and deciduous, but still strongly marked. It is that each leaf is of many leaflets, of a pale, yet warm and glowing green, and that, looking at the tree, you see that they seem to back each other, and hang rank on rank into the depths.

The basswood is an excellent tree to plant. It grows rapidly—soon the smooth tall sapling will swell into the thick rough trunk, and the broad soft leaves form a wide arbour overhead, while the mass of rich white blossoms will, if you plant trees enough, feed your own and your neighbour's bees till both shall have honey for winter. If we choose to be epicures about shade, it is thought that, as a rock gives cooler shade than a forest, so a basswood gives more agreeable shade than other trees. In this case, it is said to be owing to the foliage—the numerous layers of large, thick, moist leaves.

Then there are the larches and evergreens, the growth and appearance of most of which is elsewhere described.

Of the maple, hard and soft, much has been said elsewhere. For shade, there is no better tree, and in summer rows of maples, well-headed and thriving, form a most brilliant feature in the landscape—in fall—one almost gorgeous. A word also should be said concerning the soft maple. In most places there are some grounds which cannot well be drained, and are consequently unproductive. If soft maples be here planted, close at first, thinned out thoroughly in time and given full space, they grow to one of the finest of our many fine trees. Soft maples of which I remember the planting are now nearly four feet through at the base. Their growth, dividing, not single stemmed, and the broad branching head, renders them excellent for all ornamental purposes. Their autumn leaf, too, is of a far more rich and delicate crimson than is that of the hard maple, and if you will plant them in a northern exposure, where they will receive the full weight of the first sharp frost, you will have nearly every fall the most pleasing sight nature can afford.

If we want a rapidly growing tree, there is the silver poplar. In twenty years I have seen it cut down—a tree three feet six inches through, seventy feet high, and sixty in spread, giving four cords of firewood to the tree. It is of very fine appearance—its leaves silver on one, clear green on the other side, and partly of aspen nature, then fluttering continually breaks, a white and emerald sea, over its whole surface. I have had the wood tested—as firewood it nearly equals maple—as beams it is twice as tough as pine—as panels it has a beautiful yellow grain. But, as before warned, near ploughed ground it will run and sucker.

The birch—a very beautiful tree, whether we choose the cut-leaf or the more ordinary variety. The bright white bark, contrasting against the green leaves, shows well in many situations. In winter, if you happen to pass a large birch, stop to examine it, and it will repay the time, and prove that trees were meant to please the eye in that as in the warmer day. The great trunk below—the subdividing pillars of clear bright white above—the wonderful ramification of abounding branch, twig and bud, all arranging themselves as they grow in a careless gracefulness of forest architecture which the painter can indeed imitate, but could never imagine, is worth thought and study. The branches of the weeping birch possess even a more mournful beauty than that of the weeping willow.

“Where may the grave of that good knight be?
It lies on the slope of the mighty Helvellyn,
All underneath a young birch tree.”

“Nothing,” it is said, “can well be prettier, seen from the windows of the drawing-room, than a large group of trees, whose depth and distance is made up by the deep and heavy masses of the ash, oak, and maple, and the portions nearest to the eye on the lawn terminated by a few birches, with their sparkling white stems and delicate, airy, drooping foliage.”

All of these make good timber; all head out in the open, or if grown in close plantations will form tall straight trunks with small heads. But, with these, as with all trees, it must ever be remembered that if care be given (as directed elsewhere) they will grow *three times as well* as without. I saw a grove of maples at Eastwood this summer, planted *fifty years ago* by the employes of an old admiral, carelessly, and afterwards left to be knocked about by cattle. They grew—even that is surprising—but they are now only three or four inches through.

It cannot be too often repeated that trees will grow without care, but much more rapidly with it. We ask the value of a plantation—what money it will bring, and whether it will yield returns as wheat or barley. But consider the many ploughings and harrowings—the manure—the labour given, while we give the trees none. But keep the ground around the trunk shallowly stirred, and notice how soon the timber will expand—how thick the rings of each year's growth—what wealth of leaf and branch will spring above. To this list many more trees might have been added; but they will, to a great extent, be found mentioned in the body of the work, by those who have made their growth the subject of actual experiment.

I have the pleasure of appending here some notes on four trees from the well-known pen of W. Saunders, Esq., London, Ont., who says:—

I submit hereto a few notes on some forest trees which I believe to be well adapted to the climate of most parts of Ontario, and which possess so many points of merit that they deserve to be better known.

The Norway Maple, *Acer platanoides*. This is well entitled to a place in the front rank among useful and ornamental trees. It is a rapid grower, making, when well established, from one to two feet of growth each year, and in the course of ten years under favourable circumstances will attain a height of from twenty to twenty-five feet. The Norway Maple is a very handsome tree with a beautiful round head, clothed with long-stalked broad leaves, not deeply notched, smooth and of fine texture, with a rich, deep, glossy-green colour. This species, in common with most other European trees, is much more thickly branched than any of our native maples, and on this account furnishes a more complete shade. It is as early in leaf in spring as any of the other species of maple, and retains its foliage a week or two later in the autumn, enduring such early frosts as wither the foliage of our native species, without being materially affected, and only losing its leaves after the frosts become very severe. The bark of both the trunk and branches is neatly covered with longitudinal lines, giving it a very pretty appearance when deprived of its leaves in the winter. I regard this as one of the most beautiful maples in cultivation, unsurpassed as an ornamental tree, while its perfect hardiness suggests its suitability for more extended forest planting.

The wood is valuable for fuel, also for cabinet work or building material; it is easily worked and takes a fine polish. This tree is found native from Norway to Switzerland and was introduced into Great Britain in 1683, since which period it has been in constant cultivation there; it grows from thirty to sixty feet in height. In Norway and Sweden sugar is made from the sap of this tree. A maple so useful and hardy as this deserves to be extensively planted in Ontario.

The ash-leaved maple, *Negundo fraxineæ folium*. This tree, known also as the Manitoba maple, Box Elder and ash-leaved Negundo, is not a true maple, but is very closely related to that genus. It is a very rapid growing tree, found native in many districts in the North-West, and is said by botanists to be found from Canada to Carolina. Professor Macoun in his recent "Catalogue of Canadian Plants," says a few trees of this species are found in the valley of the Humber near Toronto; also eleven miles up the Kaministiquia river, west of Lake Superior, and on an island in the Lake of the Woods. It is abundant in all the valleys of the tributaries of the Red River and of the Saskatchewan coming from the south; also abundant on the streams flowing into Lake Winnipegosis. There seems to be two varieties of this tree, a southern and a northern one, the southern form being a comparatively slow grower and tender, having the leaves of a yellowish tint and more or less convex on the upper side. The northern form is extremely hardy, of rapid growth, darker in foliage and has the upper side of the leaves concave. Those who wish to plant this tree should bear this fact in mind and procure their young trees or seeds

from a northern source, for should they obtain the southern instead of the northern variety disappointment is sure to occur. This tree is very extensively cultivated in the North-West and is the principal variety planted on the streets in the towns there. It is not a large tree, seldom exceeding thirty feet in height, and is said to reach its full growth in from fifteen to twenty years. A specimen tree of the northern form planted by myself six years ago in a rather poor sandy soil now covers a space of more than twenty feet each way, is fifteen or sixteen feet in height and has a trunk about eight inches in diameter near the base. It is a very succulent tree and in Manitoba is very liable to be attacked by green-plant lice, which secrete a sweet fluid on the foliage and this attracts large numbers of flies. I have not seen any instance of this in Ontario. From its rapid growth and low stature, and from the fact that if permitted it is low-branched, the branches almost covering the ground, it is well adapted for forming shelter belts often so important in protecting other more tender trees, crops, buildings, etc.

The Western Catalpa, *catalpa speciosa*. This species of catalpa is a native of the low lands bordering the lower Ohio and the banks of the Mississippi in Missouri, Kentucky and Tennessee. It is a vigorous and rapid grower, producing large and handsome foliage and clusters of beautiful flowers early in June. As an ornamental tree it has few equals, and notwithstanding its rapid growth it produces timber which, though soft, is extremely durable and of the greatest value for fence-posts and railway ties. It has not yet been extensively tested in Ontario, but wherever it has been tried it has thus far proved quite hardy. Having been selected by the directors of the Fruit Growers' Association of Ontario as one of the trees to be distributed among the members of the Association throughout the Province during the coming spring, it will thus be extensively tested within the next few years. On my own grounds near London it has stood the past three winters without the slightest injury, notwithstanding that on one occasion during that period the thermometer reached more than thirty degrees below zero.

The European Larch *Larix Europea*. This tree, so highly valued in Europe, has not yet been grown to any considerable extent in our Province. A few have been planted here and there for ornament, and a clump of upwards of half an acre has been planted on the grounds of the Agricultural College in Guelph for the purpose of testing its comparative value for forest growth. Trees planted by myself have grown within five or six years from two feet to twelve or fourteen feet in height. In Europe the Larch attains in the course of fifty years a height of eighty feet or upwards. It will grow rapidly in almost any soil and in almost any situation, and the wood is very durable and valuable for many purposes. The tree is very ornamental in summer, when clothed with its beautiful pale green foliage, and since it will grow freely on very poor land it should be widely tested. A recent writer has well said, "There are thousands of acres in Canada which cannot be converted into arable land, but which, if judiciously planted with European Larch would soon become most valuable and add immensely to the wealth of the nation."

PLANTING FOR SHELTER.

The following directions and ideas are from the Minnesota Forest Manual, and will be found valuable here. They are based on twenty years' experience:—

Among the objections to indiscriminate planting is this very important one. That a group or belt in the wrong place will cause the snow to drift and block up the road, while judicious planting will keep the same clear, and at the same time answer all the purposes of a wind-break. Suppose, for instance, that a farmer plants a close row or two, or more, of leaf-shedding trees, on the north or west side of the highway. Those who have for a few winters lived in the North-West know very well that the highway so planted, will be blocked with snow, and will probably be impassable the entire winter! How then, are we to prevent this? Let us plant our forest belt on the north and west boundaries of the farm; and on the south and east a single row of trees, eight or ten feet apart, to support the wires for our future fence. In this way, we get all the advantages possible from forest planting.

In the first place, we have considerably ameliorated the rigour of the climate; we have our timber lot easy of access, as it is on the highway; we have a row of trees for live posts, and for ornament, which will never cause the snow to drift, and we have the south and east sides of the farm open to the public view, so that we can see and be seen by the travelling public. And in addition to this, we can also use the outer and inner row of our forest belt to support wires for fencing; thus having a living row of fence posts around the entire farm, which will not need renewing in our day and generation. Then across the way, we have the benefit of our neighbour's forest belt, to protect us from the south and east winds, which hardly ever cause the snow to drift, as it has been observed that nearly all our blizzards come from the north and west; and further, we have a highway so plainly defined, that the wayfaring man need not get lost in the storm.

Plant heavily on the north and west, lightly on the south and east, evergreens, if possible; if not, what you can get.

If we would grow tall, straight forest trees, we must have them quite near together when small. If too far apart, then they will take the form of shade trees, having short trunks and wide spreading tops, which are not desirable for a valuable forest of timber. Trees planted twelve feet apart, as some are doing, will never make a valuable forest. And when would we begin to thin it, in consequence of its becoming too close on the ground? I should not look for that time to come in my day; for when we cut one tree we have a space of twenty-four feet. If we plant closely, we will have an annual return for our labour a number of years before we would think of cutting a tree, if we had planted twelve feet apart, and the trees still left will be of far more value. They will not be mere shade trees, having short trunks. They will be tall straight trees, useful for any purpose. There is another benefit derived from close planting, for if well cultivated, in two years they will take care of themselves. But, if planted twelve feet, we may keep on cultivating at least five years, and then we have but little value.

"The value of close planting can be realized much better after the very sad experience of 1874. There are several points that may be urged for close planting. The force of these observations will be much better appreciated when we have carefully examined the facts which can be adduced by experience. Trees should be planted closely.

1. For the mutual protection of the trees.
2. For economy of culture.
3. For immediate protection.
4. For the purpose of securing available timber.
5. For the purpose of securing early returns from our planting."

Again, in speaking of planting twelve feet apart, he says:—

"Trees thus planted will not serve the purpose of a forest, but virtually become an open orchard."

Judge C. E. Whiting, of Monona county, Iowa, remarked in 1869 that he had at first planted Cottonwood eight feet apart each way, giving each tree sixty-four feet of ground. They grew well, but too many branches in proportion to the amount of body wood. He had adopted the rule of planting three feet each way, giving nine square feet to a tree, and in this order they grew tall and straight, soon shaded the ground, and in three years needed no further cultivation than thinning as became necessary.

It has been found that belts from seven to eight rods in width are, all things taken together, the best. These belts should be planted on the outside with some evergreen whose roots strike deep into the ground and do not spread near the surface, and whose leaves and branches will afford protection from the winter winds. In the center can be placed the deciduous trees. The trees for planting should be those best adapted to the soil and situation, and will vary much with different localities. There are, however, certain trees, such as the larch, Scotch and pitch pine, that are so well adapted to dry soils, rich or poor, and the Norway spruce, Scotch, Austrian and white pines, American arbor vitæ and ash, which are best for moist, rich soils, and which so fully meet the wants of the farmer, that they should always form a large portion of his planting. Belts composed of Scotch pines, Norway spruce, white ash, and European larch, planted from the outside of the belt, in the order named, have been found to meet, in almost every particular, the need for which they are planted.

Speaking of evergreen planting, it is remarked :—We drive over many weary miles of this kind of country ; but we must acknowledge that it is very cold.

But here, at last, we find a different scene. The atmosphere has changed,—it appears to us by contrast,—to that of Indian summer. We hear the wind howling in the air overhead, but we do not feel it as we did ; but, now, what is the matter ?

Here are some hundreds of evergreen trees, disposed in groups and belts, about a farm-house, which we find, on enquiry, to have been transplanted from the forest a dozen years ago. Here we have a bit of summer in the middle of winter.

Nothing very fine yet, it is true, but promising much in the future ; but still enough to add much to the attractions of the home ; enough to reduce the cost of winter's fuel quite noticeably ; enough to shelter every living thing about the place in the coldest storms, of the coldest winters ; and, enough to repay the planter many times its cost in beauty alone, for “a thing of beauty is a joy forever,” and is worth striving for, even on a farm.

When it is taken into consideration how easily the different kinds of native varieties are transplanted, and how very fast some of them grow, in almost any kind of soil, we are greatly astonished in traversing the country, to see how very few people have availed themselves of the bountiful supplies which nature has furnished.

That sort which is found to succeed best in your locality, is the sort most largely to plant. For instance : In this part, there is nothing like the white pine. We have planted a hundred fold more of this than of any other variety. One on the lawn, twelve inches high when planted thirteen (13) years ago, measures to day, with tape-line, eight (8) inches from the ground, forty-one (41) inches in circumference, and twenty-one (21) good long paces around the lower tier of branches. The pines—Austrian, Scotch and black, are all good. So is red cedar and arbor vitæ. So, also, is balsam fir.

Any soil that will grow a good crop of wheat, will be suitable for evergreens. It must be well prepared—deeply plowed, and finely pulverized. A good plan is to prepare a strip, where there is to be a permanent wind-break, on the north or west side of the lot, which it is desirable to improve ; and for two rows of trees, of large growing kinds, as the pines or spruces, about twelve feet wide ; for smaller growing sorts, ten feet will do. In this strip mark out two rows, or draw two lines five feet apart for the large, or four feet for the smaller growing kinds.

Now we are ready for the trees, and if they are to come from the forest, we choose a rainy, or at least a cloudy day in the spring (never in the fall), just about the beginning of seeding ; or, if time is no object with you, wait till the buds swell (don't wait till they have grown), the time of which will vary nearly a month, in the different varieties. This is the *very best time* to move all sorts of evergreens, although we know that an expert can transplant them successfully at almost any season of the year. Take your waggon, a few wet horse-blankets, to cover the trees as fast as dug, and go to the place previously selected, and carefully dig and cover up such trees as you wish, always remembering—and *I wish to impress this fact upon the mind of every one who undertakes his business* :—THAT THE ROOTS MUST NOT BE ALLOWED TO DRY IN THE LEAST, or be exposed to the sun or wind for a moment, if you wish first-rate success, and if the roots should become nearly dry, throw them away at once, as it will only be labour lost to take them home and plant them. And also, if you wish to make fine trees in the future, you must be content to select small ones now, from two to eighteen inches high ; the smaller the better. Nursery grown trees may safely be somewhat larger ; but even in this case small ones will be best, and they will certainly cost less. If you are obliged to use nursery grown trees, select to order your trees early ; *don't be put off till June*. Two or three-year old seedlings, which will be from two eight inches high, will be most profitable, but if it suits your case, get them larger.

Having brought our trees through the first season all right, we are apt to congratulate ourselves that our work is done. On the contrary, here is just where many planters suffer shipwreck. Now is just the time to make or mar the beauty of our trees, if we wish them to be what evergreens ought to be, with branches sweeping the ground, in all the

luxuriance of full foliage. In order to attain to this perfection of form and foliage it is necessary to keep down every vestige of weeds and grass while the tree is making its new growth, as the young shoots are then very tender, and those in contact with the grass will be smothered. This can best be attained by thorough cultivation where we have them in rows. After a tree has attained its annual growth, say about the last of July, it will be able to take care of itself; yet, if time can be had, it will be well to keep all grass and weeds away from it always. For trees on the lawn which are not yet large, a good plan is to invert the sod with the spade to the depth of three or four inches each spring, say in May, six inches to a foot outside the lower limbs. This keeps the ground mellow, and also, for a time, kills the grass; but this plan will only be allowable in good, rich soil, and will not do at all in sand. Here we must mulch with good rotten stable manure, and to get the full benefit of it, the operation should be performed every fall, and if too much material should accumulate, scrape away the old before applying the new. And this mulching is not understood as it should be. We must not pile up little conical heaps of stuff about them, but spread it beyond the lower branches six inches or a foot, quite thickly on the outside, and growing thinner as it approaches the centre, where it is not necessary to have anything, as the foliage itself will keep that part of the earth moist; and thus we have a kind of reservoir, in the middle of which is the tree, and which will retain the moisture which falls on the branches. In this way we keep the soil rich and loose for the small rootlets, which will always be found to extend further out from the trunk than the branches, and of course these must be fed if we wish the tree to prosper.

After lawn trees, in good soil, have grown to large size, say twenty feet and upwards, it is only necessary to attend very carefully to keeping down the grass, mowing once in ten days till the tree has attained its annual growth, which will be as before stated, about the last of July. If the soil is poor and the tree does not seem to do well, a good plan is to mulch *heavily* with good rich manure in the fall, and remove again in the spring, after the rains shall have washed the substance of it into the ground. Neglecting to attend to these things will assuredly, in time, cause the lower branches of most varieties to die out, and thus give us a poor, scrubby-looking specimen, only fit for the woodpile.

Never plant your evergreens in the fall of the year, but do it in the spring as early as you can obtain the trees.

Do not set your trees in the ground deeper by an inch than they stood in the nursery. Use no manure of any kind in planting evergreen or larch, but let the soil be mellow and friable, without lumps in contact with the roots.

Never dig deep among the roots of your trees, but keep the soil mellow and moist at the surface by a light mulching of bruised straw or hay, that will prevent the weeds from growing.

There are two different ways—each having its advocates—one by mulching, one by keeping the ground stirred above the roots of a tree. But if the last be used, we must remember it is only the surface we stir. This will vary in different trees. With some we may go much deeper than with others, yet not disturb the roots.

On tree pruning, a great difference of opinion exists. You don't want to prune your trees late in the winter, nor when the sap is flowing freely. As to the exact time when to prune, I do not attach much importance; so do your pruning as soon as the tree needs it. When you grow a young forest, you can almost do your pruning with your thumb and finger, by pinching off the young shoots soon after they start. But, when you have neglected this, and the limbs have been allowed to have their own way any length of time, then the pruning knife or saw must be brought into requisition. In my own experience, I have found any time after the leaves are full grown, until late in the fall, is a good time enough to prune. I doubt if any rules can be properly given on this subject. Your own judgment and common sense must direct you largely in this matter. For wind-breaks, very little, if any, pruning is necessary. For a shade tree, you so prune to form a wide spreading top; but, for a young forest, in which the growing of timber is the main object, you so prune as to get a long, straight body as free from branches as pos-

sible, and if your young forest has been as thickly planted as it should be, nature will do most of the pruning, nearly or quite as well as need be.

Bryant says :

"In pruning young trees designed for timber, the symmetry of their form is the first consideration. When taken from the seed bed, all side branches should be cut off; only one leading shoot should be allowed, which must not be permitted to fork. All side branches which approach in size and vigour to the leading shoot, should be shortened or cut off entirely. Suckers from the base of the tree should be cut away."

Fuller says :—

"If the trees are properly pruned when young, there will be no necessity for taking off large branches when they become old. Too many branches must not be taken off at one time, as leaves are indispensable to growth; but young trees may produce more leaves than is necessary for a healthy growth, and a reduction in number may increase rather than decrease strength. * * * Pruning should not be practised to such an extent that the tree may be eventually weakened or checked in growth. * * * Trees, when standing alone, should have at least two-thirds of their height occupied with branches. But, when grown in thickets, and for the purpose of producing timber, this rule may be reversed, and the branches occupy only one-third, varying the rule according to the natural habit of the tree. * * * Midsummer is the best time to prune all resinous trees."

In pruning, use a sharp knife, and make a clean, smooth, upward cut. Should the branches be too large for a knife, use a fine tooth saw, smoothing off the wound with a sharp knife. Where large wounds are made, an application of common grafting-wax, or cow-manure when warm, will exclude the air until there will be little danger of decay.

In a young growth of natural seedlings, the plants are often densely crowded; but as they become larger the feeble ones die, and others lose their lower branches; and so from year to year, the numbers diminish in the struggle for life, until but a small part of the first number comes to full maturity. The careful forester seeks to imitate this process of nature by securing a sufficient growth for shading the ground from an early period, and by reducing the numbers as the trees increase in size. These labours include the clearing out of the worthless bushes and brambles that never come to useful size, but is chiefly secured by giving the greatest opportunity possible to the most valuable kinds. No rules can be given for the execution of this work, without knowing the conditions, further than the general statement, that it should be done wherever required, and as often as may be necessary. In pruning, always cut close to the body or limb; then it grows over easily. If a small projection be left, that also grows over, and rots inside, doing much harm.

THE WATERSHED OF EASTERN ONTARIO.

There is no part of the science of forestry more beneficial than that which teaches to keep covered with forest the principal heights of land. These, especially those which are termed watersheds, when covered with extensive woods, form reservoirs which supply the sources of numerous rivers, give moisture to the numerous small lakes and watercourses which intersperse the slopes below them, and preserve throughout the whole country a fertility, invariably much impaired when the forests above are destroyed.

The chief watershed in Ontario extends in the shape of a crescent, the centre trending to the north, the ends touching respectively, near Kingston and Lake Nipissing. From and through this, many watercourses run to the east towards the Ottawa, and many more in a westward direction towards Lake Ontario. On this elevated section of country, therefore, the forest should, above all other places in Ontario, be preserved.

It happens luckily for this purpose that much of this territory is of an inferior character, not adapted for agricultural purposes, while it contains much valuable pine

and other timber which it would be extremely desirable to preserve, both that this height of land may remain wooded, and to answer as a reserve of timber.

In order to examine this matter thoroughly by personal observation, I have, this summer, travelled from Ottawa to Lake Nipissing, and from thence back to Kingston, thus passing around and through much of the district in question, observing what progress had been made therein, and obtaining from lumbermen engaged in its forests, opinions as to the best method of preserving them.

A few words may well be said here concerning Ottawa. To this point logs are floated from most of eastern Ontario, and from all that portion of Quebec which the Ottawa drains. Here, every day, all summer through, comes the stream of timber floating down the turbid current, after its journey of hundreds of miles down the Ottawa—the “Utawa’s tide” immortalized by Moore—passing by many a dense forest and many a fire-wasted shore, or, before that, down the dark and winding Mattawan, the Petewawa, home of many a rapid, the far stretching Coulonge, or even, now that steam has overcome the obstacle of the intervening neck of land, from distant Nipissing and many streams that terminate therein. There are numerous mills in the back country, and what they cut passes on by rail. But the great mass comes in log and is sawn up at Ottawa—that city of two great industries—the home of legislation and of saw-mills.

Where Ottawa stands, the river pours its dark waters over a ridge of rock which, at that point, crosses the country. The ridge does not span the river in a straight line. Its centre is bitten out by the tooth of time, and into this central gap the river, flowing till then broad and level above, pours all its waters suddenly from three sides at once. The result is marvellously beautiful—the whole immense acre-broad cauldron boils in milk-white mountains of half water, half vapour. This is the Chaudiere—the boiling pot. This vast mass of falling water is turned to the uses of science—clusters of great saw-mills occupy all along its edge, using everywhere the overplus of the stream, and are even built out over one side of the cauldron itself. Here they are ever at work, their great chains drawing up a constant succession of logs from the river; you see a dozen soaking monsters at once on the floor opposite, each being carried hither and thither to the great saws that evermore go up and down—a log passes you, losing two outside slabs as it goes; it comes back through a gang of saws that cut it into twelve boards; it passes away on wheels; it is succeeded by others and again by others—a treble line of timber day and night is passing in as logs and out as lumber. Down the river perpetually come logs by the thousand, divided off above the mills by booms, each coming to the mill of its owner, directed upon the toothed chain by the pike-pole, and drawn by it to the saws. Here, too, continually small portions of rafts—a score of pine logs with, it may be, four heavy beams pinned above—each with its crew and their little wooden shelter from the rain, pass down through long narrow artificial waterways planned to round the cataract, by gentle successive falls, to be united in larger rafts below. All the scene—the numerous mills, the centres of enormous piles of bright, new boards—the ever coming and going lumber—the rattle of the different machines from all quarters, the all-pervading sound of a hundred great saws forcing their way through wet pine wood—the crowding thousands of men, horses, and carts everywhere, swarming in the mills or manœuvring in the roadways around, give a picture not to be surpassed except, perhaps, by itself at night, when the electric lights colour with silver all the scene, and show in vivid glow the dark waters of the Ottawa, and the freight of logs ever pouring towards the open jaws of the mills. You might imagine the workers the swarm of demoniac Genii forced to build, on pain of Eblis, Aladdin’s palace in a night.

A great part of the city of Ottawa is a city without residents—a city of lumber. Here are piles of lumber—square piles—quadruple piles—diagonal piles, built tier on tier high in the air above—lumber for all intents and purposes—acres of inch boards—mountains unending of joists, beams, sheeting—every sort and kind of lumber which our forests give; streets of lumber, blocks of lumber—miles on miles of lumber—and when past it, it is lumber still, for here are numerous large houses crammed from earth to rafters with short lengths for pails, for boxes, for purposes beyond count. Fast as the great mills build the city up, so fast great railway trains and multitudes of immense barges pull it down and carry it away. The air is redolent with the smell of lumber; you

breathe pine and resin at every step. From here again this great mass of wood, coming but by one channel, leaves by many, and spreads itself by a hundred railways over all the Northern States, and by river to Quebec, to England, and to the Continent.

At Ottawa, the head-quarters of many leading lumbermen, some valuable opinions were obtained from Messrs. Pattee, Bronson, W. Mackay, J. Gordon, and others well acquainted with the Ottawa woods.

Leaving Ottawa, there is nothing to chronicle in the interests of forestry until Pembroke is reached, where many gentlemen experienced in lumbering and forest operations are seen and their views obtained.

After Pembroke, the next stopping place is Bissett's Creek, where :—

Mr. McCormack, the manager for Young's estate, attends to extensive lumbering operations, and proposes to take me to the nearest scene of action, twelve miles over the hills, which here are seen in all their autumn beauty. A lumber waggon is equipped by filling its box with clover hay. Mr. C. sits in the rear, I and the driver on the high spring seat in front. "Get along," he cries. The whip is cracked, two sturdy horses are doing their best, and we are rolling, jolting and tumbling over the roughest road in the universe—up great ranges of hills, down them, over rough corduroy logways in the gullies, over rocks on the level, over great stones everywhere. The waggon rattles down a hill, and rushes across a hundred boulders—you are thrown violently against your companion—you are thrown to the other side—you fly a foot upward by the action of the springs you fall a foot downward by the action of gravity. Holding to the seat till your arms are numb, you ask what is to be the length of the journey. "Four hours," replies the imperturbable Mr. C. from the rear. Rattle! smash! bang! You wonder what four hours in purgatory are like—or whether the German stone-roller trough of torture was worse than this; and at last, seeing your companions not at all affected, you begin to get used to it. The prospect from the waggon is but one of many—it is a *brule*. Sixteen and fourteen years ago—one great fire meeting the dead edge of the other—a tract here seventy miles by ten or fifteen, almost without exception a forest of noble pines, was burned into desolation. Pine went there which would have brought many millions now—a forest was destroyed which, continuing a forest, would have brought large sums yearly. Far as the eye can see, closely standing, are the dead trunks of great pines, below them a youthful forest of poplar bright with yellow, and birch still in its greener hue—below again a dense dark red carpet of ferns—of blue berry—of wild peppermint. From noon till night we toil along through a scene of such wilderness where the partridges are

"So unacquainted with man"

that they walk like barn-door fowls beside the waggon. At last a ruddy glow, not from door or window, but from the roof of a large, low log house, and half-a-dozen "Bon jours" from choppers lounging outside, show that we have reached the shanty.

"It is a lodge of ample size
Though strange of structure and device
Of such materials as around
The woodman's hand had readiest found.
Lopped of their boughs—their huge trunks bared
And by the hatchet rudely squared
To give the walls their destined height—
The sturdy oak and ash unite."

But not exactly so—all here is pine. The shanty is forty feet by thirty inside; a great square opening in the roof lets out the smoke from a fire in the middle of the floor below—earthen there—pine all around. Rows of bunks, two stories high, formed of logs and slabs and filled with hemlock boughs of pleasant odour, covered with thick grey blankets, form the beds. A line of flattened logs form benches round the room. The ubiquitous cook is balancing on an immense crane vast pots over the fire, and soon all are busy with tin pans of bread, pork, beans and strong tea. It is an interesting and animated scene—the great bright fire lighting up the sturdy forms and bronzed visages around—the sober dress of Ontario—the bright colours and gay sashes of Quebec—the chatter in French and English—the pipes inevitable and numerous after supper, adding

to the smoke-clouds "rolling dun" through the roof, while a fiddler, always found in such an assemblage, plies his cheerful instrument for hours. At last, however, drowsiness prevails, and every axeman finds his bunk, pulls his blanket over him, and a chorus of snoring fills the air.

Next morning we view the forest. It is a vast pine limit, extending—here dense with far stretching succession of multitudinous pines, there lightening with a grove of maple or of birch; here again opening into a beaver meadow, its rank grass an island of herbage in the forest sea—for many miles, from the near Bissett to the far Petewawa. The foreman, Mr. Hall, accompanies us to the places where trees have been lately cut down for saw-logs, great piles of which are already placed on roll-ways ready to be taken by the winter sleighs to the river, here four miles off. All around are spread in confusion the *débris*—numerous balsams cut to clear the way, piled in heaps around or scattered, "Anywhere, anywhere out of the road," rejected butts of logs, great tops of trees, a ready fire road indeed should sparks in summer drought light on their inflammable surface.

"Yes," said Mr. Hall, "no doubt they are dangerous. There would be but one way, if we were to clean up after ourselves—that is to carry them all into piles in as open spaces as possible, leave them till next year, and burn them then; they would not burn well when fresh. I do not know what it would cost; that would be found by experiment—but no doubt it would leave the forest in a less dangerous condition."

Everywhere here, the whole week long, re-ounds the crash of falling pines. Two athletic young fellows, clad in the strong home-spun of the settlements, if they are lucky enough to have those who will weave it, if not in the less durable "store goods," yellow leather moccasins, bright sashes round their waists, the great rolling muscles standing out and working visibly on arm, back and shoulder, stationed at the foot of a tree, swinging with easy grace their long handled axes against the trunk, great chips flying right and left like hail. The tall tree totters at its base, and falls, the sound reverberating for miles. The choppers climb on the log, trim the branches as far as they need; one, two, three or more lengths are cut from the trunk, and it lies till the horses and sledges can draw it to the river.

All through this great extent of pine and lesser hardwood—in densely-wooded slope or opening of lake and beaver meadow—vales dark and deep as that of Hinnom, where the great pine tops, broad and green, scarce reach the level—mountain tops where they wave dark defiance to the elements—everywhere lie the trains of great chips—the abandoned tree-top—the smaller trees cut to clear the way, now obstructing it—all around. It has been lumbered over for years, and with care might be forever. "No fires just here of late," says the foreman, "but there have been many in the country."

After our journey back to the depot, from a high plateau, we observe one of the many magnificent views obtainable here. For thirty miles you look down the great valley of the Ottawa—the distance closed by high mountain ranges—the sides bounded by them twenty miles apart. Along the valley, broad, tranquil, its gently moving waves shimmering at hand—placid in the far distance—the great Ottawa rolls its sinuous length. Half way along, rounding its way beside a large island, which, covered with undulating poplar, bars its course, the Bissett joins the greater stream. Here lies before you at this season an amphitheatre so immense, of colours so varied and so gorgeous, as scarcely eye hath seen elsewhere. All these circling mountain sides are clothed in the richest colours. Here the waving poplar covers them with the brightest yellow, there where only undergrowth flourished they are dark red brown; farther again a forest of young pines, gleaming bright green in the sun, ascends from river to summit, and everywhere interspersing, wearing the gayest hue of all, are great stretches of the soft maple, crimsoning all the landscape, and adding greater beauty to what, even without it, were most beautiful. But to view it in perfection, you must approach it in early morning, when the dense mist, rising from the low grounds renders all else invisible. Presently this will rise, gather itself in great billowy columns across the sky, move in rolling masses to the far distance, and out of sight. Then the curtain of nature has risen, the vast panorama is spread out before you, mountain and valley, forest and herbage glistening with dew; bright with the morning sun, and the great river below all, an immense serpent of molten silver, winding his devious way to the distant sea.

The next stopping-place is Mattawa; where further statements from Crown Land Agents, storekeepers, settlers, etc., are had. After leaving it:—

At six o'clock in the morning we reach Mr. W. Mackey's mills at Benton, where, as the light grey mist which shrouds all, gradually disappears, you see first a pretty lake shining below the rising wreaths. A little more and shelving hills appear, covered with yellow brushwood, surrounding it on all sides. And later yet, when clear and bright, the landscape glitters in the autumn sun, we see the destroying fire has wrought terribly here. Far around as the eye can follow, a breadth of many miles is clothed with brushwood, little pines, infant cedars, multitudes of sapling poplars, forming in red and yellow shadings a brilliant contrast to the shining sheet of water in their midst—but, nevertheless, a sad one. For all among these are the stumps, the trunks, the standing spectres of what was once one of the most valuable pine forests in North America. How rich in pine it was may be seen by the limit Mr. Mackey possesses just where the fire stayed its work, a block of ten miles square which he has cut through again and again, and which is yet a grand pine forest, fit to remain, fire permitting, a productive pine forest for ever. Here great rafts of timber have been taken out of small spaces, and saw-logs innumerable floated down to the saw-mill established near, which is in full operation, the roll and dash of its rushing water striking steadily on the ear, intermingled with, at momentary intervals, the sharp hissing cutting sound of the circular saws as the logs are driven against them. It is a saw-mill so complete, well adapted, and thorough for its particular purpose, as to merit description. Here, above the water, stands a young *habitant*, bright in parti-coloured cap and jacket, his pike-pole guides a monster floating log near the spiked chain, it feels the point, it shivers, and seems feebly to resist its fate, as it is dragged up into the mill and deposited on a platform; rolled thence on a movable one, which, bearing three men, passes rapidly back and forth beside a circular saw; it passes up and loses a slab, back again, another is gone, and both run automatically along a platform of rollers outside; the remaining portion is rolled to another platform, manned likewise, and cut into boards; they pass to a stationary one covered with rollers, where a small saw squares their ends, and at this point they are out of the mill and borne on tramways to the board piles. About fifty men are around the mill. It is the most busy of scenes. All day the logs climb in—all day the boards pass out.

The manager here, Mr. Ryan, thinks that but little can be done, unless at great expense, to clear the forest of rubbish after lumbering. Chopping down the heads, he says, might serve a good purpose where the ground is flat, by keeping the pine foliage damp till it rotted; but on a high locality or hillside they would still be dry. The chips he thinks are safer on the ground than piled.

This mill, as remarked, is in a burnt country, as it is called—or *brule*—of which there are, unfortunately so many in Canada, and to which, still more unfortunately, each passing year adds others. It is many miles in extent, and from the mill, which occupies perhaps a central position, we travel eight miles before we reach the woods, on that primitive conveyance called a buckboard—a carriage calculated, of all others, to pass over the roughest roads with the least amount of jolting—though so rough are these roads that that amount is very large indeed. All the way the great *brule* spreads out before us—a vast extent of rolling land, brown-red with the dying wild summer herbage over many a sloping hill, beautifully contrasted with thick groves of gold-leaved *aspen*, covering many another, themselves again contrasted, every here and there, with bright-green pyramids of balsams, and young soft maples of brilliant crimson hue. Over all the prospect, front and rear, right and left, as far as eye can reach, these successive hills stretch away, now and then varied along the river bank by a lofty precipice of granite rock. Everywhere, amid poplar, balsam, and underwood, rise high the gaunt dead pines; everywhere their great trunks lie rotting among the brush. The fire which took the forest has not spared the soil. Much of this is burnt so deeply that the life-giving humus has departed; a couple of crops would probably render it barren. The earth, too, is almost paved with large stones, as most of the road painfully witnesses to our shaken frames. At last we reach where, on a flat, receiving the fertilizing wash of surrounding slopes, a place has been found capable of making a farm for the lumbermen,—three or four large buildings—half barn, half storehouse—as usual, surrounding a large quadrangular courtyard. We enter the large kitchen

occupied by two French Canadians, a stout lady busy cooking dinner, a thin husbandman busy waiting for it, and an army of cats and dogs—Newfoundlands, spaniels, puppies, and tortoiseshells—all, bipeds and quadrupeds, welcoming us with the kindly manner of the native of Quebec, which even their animals seem to imitate. The feast is spread—masses of pork and potatoes, eggs, bread and butter, and the ubiquitous tea, in a tea-pot of two gallons, suggestive of occasional numerous and thirsty guests, glad of refreshment after many an hour of axe-handle and handspike. Dinner over, the horses are harnessed, and we soon arrive at the forest itself.

These broad, dark, dense woods form a magnificent specimen of a reproductive pinery. Far above you—a hundred—even sometimes a hundred and fifty feet, on all sides—straight, many branched, upright, tower the dark pine trees. These have been carefully used; the largest have been culled out—the last cutting here is three years ago—but still it is thick with pines of all sizes, from the half-inch sapling to two-feet through and more. Most of these are over a foot and a half, and of full height. These now rapidly add to their thickness, and fifteen years will give large trees again.

Every here and there, lie the long stretches of pine chips, four feet, five feet, two feet long, from the stump to the abandoned head of the tree, projecting all its branches—the *chevaux-de-frise* of the forest. These are not now dangerous—the needles—the pine leaves—being rotten. My guide, young Mr. Mackey, of some experience in lumbering, is decidedly of opinion that a few minutes work bestowed on each head at the time of chopping, in the way of cutting down the branches, and allowing them to fall to the ground, would rot the needles much sooner, and render the forest less liable to fire. As to the chips, it appears that to spread them would probably be a great advantage. A separate chip gets grown over and damp, while in piles, left, the upper ones lie dry for years. It is noticeable in this wood that there is much less timber carelessly felled to cut out logs than is observed in some others, and that this is evidently a forest which will, if given the present care, and fire allow, remain a forest. We can go on for hours; throughout the great pine wood, mile after mile, still you travel in the dense shade of the evergreen branches far above; still, rank on rank, grove after grove, the huge upright trunks stand all around you; still to right and left, front and rear, is one broad receding vista of these great pillar-like trees. Miles on miles, wherever you go, the brown-red carpets of pine leaves lie soft beneath your feet, the great rough-barked trunks rise column-like by your side, and far above, between you and the sky, the intermingling branches, with a murmuring cadence the pine-forest only knows, sigh mournfully in the breeze. A half mile on, we come to a place where hunters had carelessly dropped fire. It ran for miles, spoiling many a goodly tree, which now, its bark dead and blackened, stands in the path, but luckily rain came in time, otherwise this great woodland might have been but a *brule* now. The stream which rushes along the forest-ravine flows through the *brule* we travelled over, down to the mill we have left, and carries there the great flotillas of logs we saw waiting their turn in the stream above the mill. Half way there, a curious instance is visible of the manner in which lumbermen overcome natural obstruction. There was a long stretch of very difficult rapids foaming through a narrow and tortuous bed, the walls on either side high rocky precipices. This pass was dammed, the water raised to a great height, and a shoot made to one side, and its waters poured along a trough or slide, supported on massive timbers, for twelve hundred feet past the rapid. The slide is of thick plank, three or four feet wide, and two or three deep. The logs of course float on the surface of the raised water behind the dam, are directed into the slide, and pass with lightning rapidity to the calmer waters below, thence floating unobstructed to the mill, are sawed there, sent to Brockville, and thence, through an American firm, the world over. Besides these, large rafts, from the same sources, but of squared timber, go to Quebec.

Leaving the woods, we drive back over the long *brule*, bright with the gleam of evening, across its purple, crimson and gold surface—a thing of beauty, but not of use, and reflect that all this—hundreds of square miles—when Mr. Mackey came here, was a pine forest as beautiful and valuable as that we have left, and but for the careless use of fire, would have continued so. We see from here, in another limit across the river, a shanty of the kind previously described being erected, and near us, on this side, is the cook,

two tents near him, but the whole ground around covered with bales, boxes and tools, waiting for the cover which the newly-roofed house will give. He, in the meantime, tall, young and white-aproned, is busily employed, with his vast pots hung over a glowing fire of birch coals, and, like the mountaineer in Scott,

"Gives us of his Highland cheer."

Not the "hardened flesh of mountain deer," though a bundle of fresh slain partridges lie under his bench, but the salted flesh of the swine, with bread, butter, and molasses *ad libitum*.

The next point in our journey is Callendar, one of the head-quarters of Booth & Co.'s large lumbering establishment, where we are hospitably received by Mr. Mark Cahill, acting at Callendar for Mr. Booth, and spend the next few days in going over part of their limits.

In travelling next day with Mr. Cahill, he pointed out from the summit of a hill, overlooking a large lake, a great and almost untouched forest, mostly of pine. The scene was grand. Around us lay the grassy field of an old abandoned clearing, backed by the forest from which we had emerged, a gorgeous mass of autumn's richest coloring—high poplar clumps of leaves like waving gold, tall slender pinnacles of spruce, their light green foliage hung with moss, piercing the lofty air, while every here and there against the green and against the gold the soft maple fresh tinted by the last night's frost, shone with an intensity of delicate crimson I have never before seen equalled. The fields sloped downward to the inland lake, a vast circular sheet of little wavelets, their gently breaking edges flashing in the afternoon sun till they faded away in the deep shadows of the dusky wood which bordered the opposite shore. No gleaming colors there, all is sombre; for here we view that sight beyond others magnificent, the waving crests where far extend—right, left, and centre—to the extreme and distant horizon—the dark green billows of the great Canadian pine—an ocean of verdure alternately everywhere gleaming into brightness or deepening into shade, as the wind sweeps by, sending across the lake to our ears that deep, murmuring, softened Æolian chant which dwellers by the pine forest only hear. It is most beautiful, and might remain so. Yet it needs but a match—a careless hunter, a settler pressed by want and anxious to grow what wheat the scanty soil will yield, and this vast extent of millions of dollars' worth of pine—its possibilities of growing millions more—shall be a blackened wilderness of worthless trunks, scattered above a soil burnt into a barrenness well-nigh utter. Part of this was in Mr. Booth's limit—part is Government land. It is a wood the forester would love to keep a wood.

In the evening of the same day, examining the state in which a bush was left after most of the logs had been removed, being taken, in this case, both for square timber and logs, we found that the surface was thickly spread, here and there where trees had been squared, with pine chips of all sizes, and close by, scattered in confusion, the heads of the trees, with others, which had been felled to assist in the operation. Undoubtedly, there was much more lying rubbish than elsewhere. But Mr. Cahill was of opinion that the chips on the ground soon grew damp, and would not catch fire from sparks, though a fire once started, they would give it more material. On being asked whether, if the limbs were chopped off the tree heads after each tree was cut down, so as to form a dense pile on the ground, it would not be safer, he doubted it, as even then the top would be dry. It was, as he said, noticeable that rubbish abounded everywhere—dead branches in heaps, dry combustibles on the ground in all directions, which was ready to catch and carry fire, even in the places where no timber had been got out. To clean up after the lumbermen would be, he said, a great expense, and yet much would be left.

On Monday we left Callendar in the small steamer owned by the Booth company, and passed along the shores of a beautiful little lake, called Nosbonsing, its waters bright with sunlight, its banks on either side heavily clothed with forest. Here and there along the banks are the small clearings of settlers, but the soil, light and sandy, seems to promise little for agriculture.

It is so in much of this rugged land. But the scenery is of wonderful beauty. Our course, bending with the winding lake, shows a long succession of these inland waters.

Here a dark pine forest fringes the shore, its great trunks deepening into blackness till lost in the heavy gloom within.

"E'en to tell,
It were no easy task, how savage wild
That forest, how robust and rough its growth."

Beyond this, a stretch of hardwood wreathes the water's edge with gold and crimson. While we admire its beauty, it is past, and all the shore is clothed with low dense masses of balsam and cedar. Then again for miles the bank will show poplar and birch alone. The light and shade, too, in this clear northern air are often exquisitely contrasted. Near the bank your boat may lie in the dense shadow of a dark forest—a thousand feet off, the sloping sunbeams turn the lake to silver, and light, in breaks and gleams, the great sea of foliage which clothes the opposite mountain, till it is lost in the dark and distant ridge which stands against the sky. In this pristine beauty much of this country should remain. There is perhaps, here and there, the soil for a few good farms, but a light poor sandy loam, scant of lime, and scant of humus, seems every where around. It will grow, as long as we choose to preserve them, successions of magnificent trees, and, in the fast approaching scarcity of timber, these will form a valuable crop. But for the farmer, settlement on many of these lots would mean a life of penury and unrewarded toil.

But now, over the broad waves, through the purest air, the little boat, brilliant with white and green paint, puffs rapidly along, dark masses of foam-tipped water rolling from her prow till five miles are passed, and we land half-way to the head of the lake, where a waggon awaits us, its team of black horses quite unmanageable as the steamer nears. Three miles of a ride through a forest of birch, poplar, maple, balsam and spruce, bring us to the lumber depot, a farm of nearly two hundred acres, with many log buildings, great sheds with hundreds of lumber sleighs piled therein, and a comfortable house. Here we dine, and in the afternoon go by waggon to another lake beyond, where two stout oarsmen—French and Irish—row us a couple of miles to a river mouth where are camped a gang improving the dam, their house of logs and log-roofed, with a great opening above for chimney, whence rises the smoke from the fire built in the centre of the floor. It never, we are informed, smokes. Outside is the cooking apparatus—immense pots and frying-pans on great burning logs. The dam is examined and closed, with the effect of lowering the creek two feet for five miles, so that a gang of men clearing it out for next spring's drive can blast the stones in the bed. All the way are carefully explained the operations of the lumbermen, and we note again the *debris* left in the forest whence logs have been taken—the long lines of chips, the fallen head heavy with projecting branches, the smaller trees felled for logways and for supports while the log is being squared. My lumbering guide insists that it would be but useless to remove the rubbish, as even the virgin forest is full of lying trees. I do not agree with him. The tree falling here from natural causes is old and rotten; that felled is strong and sound—the numerous heads fill the forest with piles of very inflammable matter. The chips perhaps had better lie; they become damp on the ground, while, if piled they would dry; but every head of a tree cut should, I consider, have most of its branches "chopped down." They would then lie flatter on the ground, keep damp, and rot the sooner. This would cost but little trouble, and would be the next best thing to piling and burning, which would cost much, as, for safety, it would have to be done in winter. We embark again, and row, as evening shadows the lake, across its waters, wild ducks floating unconcernedly near us as we pass. All around a border of dead balsam trees, gaunt and bare, fringe the shore, and above them rises high a broad embossed ribbon of yellow and red—the birch and maple. The balsams are killed by the dam rising the lake. No clear inland water this—it is dark and brown with iron and copper pyrites; in our wake is a muddy foam. The depot is reached again, and in the morning we again meet the steamer at the rustic landing, and sail on Nosbonsing to its termination, whence a railroad, just built by the Booth company, leads to lake Nipissing, five miles away. Here we dine—all is hospitality at the lumber camps—and watch the great wooden room, with its numerous pine board tables and benches, filled with a noisy and hungry crowd of French Canadians, Irish, English, and more—all apparently joking and talking in six languages at once. The tables are piled with food—boiled salt

pork and beef—fried salt pork,—excellent potatoes, dry and floury, good shanty-made bread, stewed dried apples, molasses, boiled beans—all served in tin pans, and everybody eating out of a tin pan, and drinking strong tea, with sugar, but no milk, out of another. All is clean but all is rough, while the cook, generally French, in white apron, and striped stockings, makes every one as comfortable as he can.

Starting for Lake Nipissing, we find we must climb on the engine to travel along the line newly built. Passing on a little way, we see terrible evidences of fire. Here for miles, far as the eye can follow, is nothing but the bare upright whitening trunks of great dead pines surrounded by worthless brushwood. The pine is of little use after a fire—the worms attack the trees at once, and destroy them before the lumbermen could attempt to save them. Much valuable timber has been lost here. Arrived at the terminus, which, to save cutting, is seventy feet above the water, the south-east bay of Nipissing, stretching broad between its wooded banks, its surface dotted with islands of picturesque beauty, lies before us—the great expanse of water dark and tossing green below—the evening sun touching island and forest edge with gold above. Here, from the mass of logs, acre-broad, which float far below us, comes a spiked chain running in the bottom of an inclined trough 140 feet long. Towards this the logs are pushed by a pike-pole, they lie on the spikes of the chain, are carried along, and come up one after another, a string of black and wet-looking monsters, reaching from water to summit. Here they will be loaded directly on the cars, and, the five miles of railway past, they can float down the Ottawa.

Descending to the beach, the foreman and myself enter a little green skiff and embark on Lake Nipissing, where, three miles along the shore, we are to see a lumber camp just in process of formation. Neither the oars nor the boat are of artistic formation, but the boatman is powerful, the boat flies across the blue waters, and reaches a beach of white sand covered with stunted poplar and balsam. Here, on a green bank of some height, a space has been cleared, half-a-dozen tents pitched, trunks, luggage and tools lie all around, and the ubiquitous French cook, his big fire and big kettles, are at work as usual *al fresco* in the centre. This stunted bush is rising on the burnt ruins of a once magnificent pine forest. From here to the far distance there is little but *brule*, the poplar undergrowth, the innumerable lofty trunks of dead and worm-eaten pine. (This low poplar, it may be remarked, is of the aspen kind, and the whole yellow landscape of innumerable acres trembles and flutters in the lightest summer air). The fire which swept the country here has, however, spared some thousands of good pine trees in this immediate neighbourhood, and the object of the camp is to secure those which are sufficiently large. We walk a mile to the rear, and watch the process of erecting the lumber shanty. They have erected, of inferior or worm-eaten pine logs, four walls eight feet high, and are now roofing it with what are called scoops—trunks of pine trees flattened and hewn into troughs, a double layer of which, the upper layer inverted to shed the rain into the lower, forms the roof. Six stalwart choppers are cutting the grooves in these, while every now and then along the track into the bush comes a horse at full trot, his driver running by his side, a fresh flatted log of white pine dragging smoothly on the ground behind him.

Opposite the main shanty will be others for stables and stores, and in a few days the men will be in one, the horses, provender and tools in the others, and the winter work of getting out logs will commence in earnest. What is principally noticeable to the forester's eye in the whole operation is the quantity of tree tops and chips left everywhere on the ground where trees have been felled, thrown everywhere to right and left where roads have been cut already, when work is scarce begun. We again take our skiff and return to our railway terminus, as the shadows deepen over Lake Nipissing. Here we see Mr Booth, the brother of the senior partner.

We stay here all night, and in the morning by rail, and boat, return to Callender station. Next day we drive a circuit of some miles round Callender, and find settlers located in pine forests, or so near them that one fire is pointed out as having burnt this summer a length of five miles, broadening so as to include the pine strip in which it was running, but stopping at the hardwood, as is often its manner. Three fires, of which I saw the remains, have occurred in the parts of Mr. Booth's limits supervised by Mr. Cahill this summer. Many thousand dollars' worth have been lost here. Nothing is more

pitiful than the aspect of these burnt forests. The pines are spectres—the soil is burnt—all is gone. What is worst is, it goes to obtain so little. The whole farm which is obtained by the burning will seldom give \$50 rent a year for many years.

The next stage is to the north shore of lake Nipissing. We stay at Sturgeon Falls, and I see Mr. Mackey, who holds extensive limits here.

At the village of Sturgeon Falls, a small collection of new pine houses rising in all directions among a mass of stumps, surrounded by a low forest of balsam and cedar, the stream falls in a succession of small and picturesque cascades. It is now all cleared land here, but this must, when untouched forest, have looked inexpressibly beautiful. Far removed from the sounds of labour, or even the presence of civilized man, a lofty and secluded forest bordered either bank. It was a place where the Genius of the River might have been fancied descending these white and foaming steps overarched with sylvan green. Now, it is a stream falling over some ridges of rock, with a couple of sandy fields on each side.

In a bark canoe, paddled by a boatman at either end, all day long I go up this stream, passing many a mile of forest, yellow with approaching fall, dropping their overhanging leaves into the waves along which our canoe glides, silently, easily, but so slowly as ever to bring longings for the cedar skiffs of Toronto Bay, their rattling row-locks, the long sweep of their oars, and their treble speed—passing many a clump and stretch of valuable pine, darkening tall against the sky—many a great cliff of overhanging granite, its summit a hundred feet above; its lofty crags disjointed and threatening to fall, but all, firm and loose, covered high with pine, spruce and cedar, growing apparently from rock alone, their roots deep in crevices, their shafts swaying in the fierce winds that sweep along the cliff, but holding tenaciously their place—passing, too, many a long stretch of burned land, where innumerable whitening spectres of former pine trees fill the scene from the river back to the distant horizon—an interminable array of ghastly trunks above, a mass of tangled brush below, red and yellow with the colours of autumn. The roar of rapids is heard ahead, and presently here is a good opportunity of seeing one method by which lumbermen pass these obstructions. Here is a long embankment of high rocks extending diagonally across, over which the river used to plunge at two points close to either bank. Mr. Mackey, on whose limits we now are, has built all along three fourths of this ledge a mass of crib-work of heavy logs, faced against the current with a great sheeting of other logs, smooth and flat, standing on the river bed and leaning against the crib-work. This, which is 200 feet long, closes up one opening, and runs the river, and, of course logs in the driving season, over the other. Over this the whole mass of the Sturgeon river now goes with terrific force. Even yet this fall is divided—one half—that farthest from you as you stand on shore—falling perpendicularly—the other rushing down aslant—a bright green darting mass against the white foam beyond—as if a great sea monster sprang perpetually through an eternal cauldron—both together falling into a boiling gulf, rising and falling into white cataracts again, till it tears its way past the enclosing rocks, and forms again the quiet river below.

Up this cataract somehow we must get, and now we see the superior points of the bark canoe. I walk along the bank past the falls—the two men easily shoulder the boat and follow, and in the calm river above we embark again, and pursue our way up the stream, till, some miles further, we reach the Smoky Falls, so called from the vast mass of vapour which overhangs them. This fall is of unique beauty. Over high rocks, diagonal, as the other, across the river, the level torrent pours, falls in mass on a great projecting shelf not far beneath, and is thrown outward—a giant whirling semicircle of foam, falling full below, still confined by another shelf of granite crossing the river bed, and boiling white and over it to the depths beyond, across which, beneath the sun, a bright rainbow ever glows—the whole accompanied by a volume of sound scarcely imaginable.

Other sounds, however, rise above it as we look—a perfect uproar of yelling and scraping on the hard rocks—and here are a large party of lumberers, as many as can cling on all sides of a forty foot boat and pull it with ropes ahead, dragging it by main force over the portage—here a hundred feet rise and fall of solid rock. One of them hurriedly hands us a letter to post, and away they go, screaming in French, shouting in English,

down the mountain side, to embark again for their winter camp high on the banks. Here on this beach lie all the trunks, barrels—conspicuous are monster ones of molasses—tents and blankets, axes and augers—a mass of material ominous to many a grove of giant pine whose branches the north wind, their visitor for two hundred years, shall shortly know no more. But we must retrace our steps. On our way back we examine a lumber camp of last winter. It is reached by a path from the water's edge up a gulley to the level. Here is the scene of square timber "getting out," and it shows but too well how much is wasted. Here lie many great logs of good pine, three feet through, spoiled by deep cuts made to see if the heart is sound, without which it would not answer for squared timber, though quite good for sawing purposes. Here are short ends—nine, eight, seven, and four feet, in multitude, cut off to leave a sound stick, left to rot, though excellent for board, lath and shingle purposes. And here, above all, is such a compound mass of heads of trees, lying with their branches drying in the air, acres of them nearly, strewn through the woods—such piles on piles of chips and rubbish as to leave no doubt of the inflammable nature of lumber *debris*. The lying timber in the untouched forest is not so. We advance into it, near by, where no trees have been cut. What is here is not equally dangerous. All is more or less covered with moss or damp. Ignition would be here difficult—there very easy.

From these notes of the preceding journey, some idea will be had of the scenery and surroundings, among which the lumbermen carry on their hardy trade. It would, however, take years to visit, in the manner sketched, all the lumbering regions of Ontario, which are wide-stretching, and often difficult of access, while the men employed in procuring and sawing the timber form many small armies of no insignificant numbers. It is not uncommon for a lumbering firm to employ from a thousand to fifteen hundred men, and there are many firms. These men will be under the charge of perhaps half-a-dozen foremen, who will each have his district, his *dépôt* for supplies, and his shanties erected at the numerous points where his men are chopping, such as we have seen them some pages back. Winter and summer, throughout immense territories, along a thousand rough-hewn roads, up a thousand streams, supplies are pushing their arduous way to the lumber camps, with, as Horace says, "what toil of men, what sweat of horses," can scarcely be conceived. All winter the axes resound, the pine trees fall at a million different points, and all summer again great argosies of logs float to Quebec to await shipping for Europe; or, stopping at Ottawa, or some inland point, are sawed, distributed through Canada, or sent to the States.

In the tour previously partly sketched, (for of course many places were visited, and many opinions obtained, besides what space would allow to quote) I found that two suggestions seem to have presented themselves to the minds of all who considered the question of preserving our fine forests. First, increasing the number of men employed in summer to watch the forest and prevent fires. Next, the setting apart a portion of territory for forest exclusively.

After placing myself in communication with those best acquainted with the localities, I have obtained the following opinions, which appear unanimous, namely:—That there is but one territory in Ontario south of Lake Nipissing where the last scheme can be carried out, which is a part of the Nipissing District, where there are between twenty and thirty townships with few or no settlers. There are also there valuable pine forests. Speaking also from a forestry point of view, irrespective of the lumbering interest, I should be glad to see this portion kept in forest, as it is one of the chief watersheds of Ontario, and nourishes many streams flowing north, east, south and west, which, of course, are of great value to the cultivated areas through which they flow. Mr. Russell of Pembroke, Crown timber agent for the region, defines it as "Com

mencing at township No. 2 of Nipissing—Elora, Maria, Head, Rolph, Wylie and McKay in Renfrew, extending west to townships Laurier, Paxton, Butt, Hunter and Peck, inclusive.” If settlement at any bordering point has made progress, which cannot be to any great extent, the reserving line could be drawn to suit it. Much of the region is unfit for agriculture, but would be very valuable if kept in forest.

It appears to me that throughout the whole country visited, as well as, from report, many parts adjacent, settlers are too apt to locate themselves on soil unfit to be of lasting value for agricultural purposes. It is evident that if this could be checked by directing these men to better and separate localities, it would tend greatly to reduce the number of forest fires, for settlement necessitates the use of fire in clearing, and, especially when at all carelessly managed, the fire is too likely to get beyond control, and spread far into valuable timber. Such men as were retained in summer to watch fires could, I should think, in certain localities, being themselves well acquainted with the country, direct settlers to proper sections, and act in conjunction with the Crown Land agent in charge. It has been suggested, also, that if settlers who set out fire were obliged to give their neighbours notice, proof could then always be obtained as to whether it was done carefully or not. The general opinion is that lumbermen, settlers and sportsman are alike too often careless in the use of fire, and that some measure should be taken to enforce the provision of the Fire Act by all. This, and the suggestion concerning a reservation of land in the Nipissing District, are the two measures I consider needed, as far as the country south of Lake Nipissing is concerned. It is important that some steps should be taken in the matter, as the loss by fire is very large.

FOREST RESERVATIONS IN QUEBEC.

The Hon. W. W. Lynch, Crown Lands Commissioner, Quebec, states in his report of last year, speaking of the forests:—“So important a source of revenue cannot receive too much of our attention; and the means which should be adopted, in order to prolong its existence to an indefinite period, ought to be the subject of our most serious consideration. Our forests have not to be created; they have only to be preserved; and if they can be but protected from the disastrous fires by which they are so often devastated, the present rate of production, with judicious management, may be continued without any danger of their becoming exhausted. By a series of untoward circumstances, I have hitherto been prevented from availing myself of the means placed at my disposal by the Legislature to establish a more efficacious system than that now in use for preventing the spread of fires through the forest. I anticipated receiving the unanimous co-operation and aid of holders of timber limits and all who are interested in the working of our forests. Very few of these have responded to my appeal; and I have been obliged to postpone to a more favourable opportunity the execution of the project which I had conceived. It has, however, been possible for me to take some steps towards the attainments of this object, though indirectly, by giving effect, in the most richly wooded districts in the Province, to the provisions of the Act, 46 Vic., cap. 9, concerning forest reserves. By the Order-in-Council some months ago, the unsurveyed portions of the St. Maurice and Upper and Lower Ottawa agencies, with some of the subdivided lands in the same agencies, and the rear townships of the counties of Compton, Beauce and Dorchester were included in the limits of forest reserves specially described and defined. In order that the progress of colonization may not be interfered with, wherever it is desirable and expedient that it should advance, I have had an inspection made of every lot remaining unsold, or sold but not patented, in most of the townships comprised within these reserves. With the

information thus procured, and revised in the department, the local agents will be in a position to dispose of the public lands to good effect. The real interests of colonization will thus be protected, while it will become possible to prevent abuses and check the waste of timber which has been going on without profit to the State.

The following Act has reference to these reserves :—

AN ACT to further amend chapter 23 of the Consolidated Statutes of Canada, respecting the Sale and Management of Timber on Public Lands, and the Act amending the same.

Her Majesty, by and with the advice and consent of the Legislature of Quebec, enacts as follows :—

1. The Act of this Province, 39 Vic., cap. 11, is amended, by adding at the end thereof the following sections, which shall be taken and construed as forming part of the said Act :—

“(5) The Lieutenant-Governor in Council may, as soon as the necessary information can be obtained, after the coming into force of this Act, set apart as : “Forest land,” all the ungranted lands of the Crown now held under licenses to cut timber,” except such parts of such licensed lands on which no merchantable pine or spruce timber grows and which are fit for settlement, and also such other portions of the ungranted lands of the Crown as the Lieutenant-Governor in Council, on the recommendation of the Commissioner of Crown Lands, may think fit so to set apart; and as soon as the order or orders-in-council setting apart such forest land shall be published in the “Quebec Official Gazette” and from and after the date of such publication, no land included in the territory so set apart shall be sold or appropriated for settlement purposes, until after the expiration of at least ten years, and not then until after it is established to the satisfaction of the Lieutenant-Governor in Council that the whole or any portion of such territory may with advantage be opened for settlement. The order or orders in Council withdrawing such territory shall likewise be published in the “Quebec Official Gazette.” The land so set apart shall be known and designated as ‘Forest reserve.’

“(6) In the renewals of licenses effected after the publication of an Order-in-Council creating a forest reserve, it shall be the duty of the Commissioner of Crown Lands to exclude any land theretofore under license in the locality, and which is not included in the reserve.”

“2. Whenever any such lands cease to form part of a “Forest reserve,” and for the purpose of securing to settlers who may thereafter occupy the same, the timber they may require, to facilitate the performance of their settlement duties, section 2 of the said chapter 23 of the Consolidated Statutes of Canada, is amended, by adding after the words : “in all,” in the sixth line thereof, the following words : “red and white pine, spruce, tamarac, birch, oak, walnut, cedar, butternut, and basswood.”

“3. After the coming into force of this Act any license issued for the cutting of any timber under the authority of the said chapter 23 of the Consolidated Statutes of Canada and its amendments shall contain a special description of the trees, timbers and lumber, which it is permitted to cut thereunder, and they shall be of the kind mentioned in the preceding section and none others.”

“4. This Act shall come into force on the day of its sanction.”

It may be mentioned that the reserve set aside under the Act quoted above, and mention of the Crown Land Commissioner, Quebec, are of very large extent, containing many thousand square miles.

FOREST RESERVATION BY THE DOMINION GOVERNMENT.

The Dominion Lands Acts was, last session, at Ottawa, amended thus :—

“The Governor-in-Council may, from time to time, for the preservation of forest trees on the slopes and crests of the Rocky Mountains, and for the proper maintenance throughout the year of the volume of waters in the rivers and streams which have their sources in such mountains and traverse the North-West territories, reserve from sale, lease, or

license, such portions of the land in the North-West territories on, adjacent to, or in the vicinity of the Rocky Mountains, as to him appears expedient as to reserve, and may define the limits or boundaries of such reserves, and may set aside and appropriate such land for a forest park, or forest parks, as he deems expedient, and may appoint officers for the preservasions of such reserves or forest parks."

The following clauses states that cutting of any tree or surplus in such reserves is punishable by fine from \$10 to \$100 and costs, or punishment of not more than three months.

FOREST RESERVATION IN THE UNITED STATES.

To mention what is being done in forest reservation in the States, a bill passed the Senate last year, at Washington, setting apart nearly eight thousand square miles of land in the territory of Montana, choosing the highest ground and the head-waters of various rivers for the purpose. The bill is expected to pass the lower House this session.

In 1883, the State of New York, finding the head-waters of various rivers, notably the Hudson, rapidly decreasing in volume by the clearing of the woods near their sources, passed an Act forbidding the sale of any land owned by the State in the counties of St. Lawrence, Franklin, Clinton, Essex, Warren, Washington, Saratoga, Fulton, Montgomery, Hamilton, and Lewis, in which the State owned one-half the land, or 750,000 acres.

FORESTRY IN THE UNITED STATES.

Throughout the United States, greatly encouraged by the efforts of the Central Forestry Department at Washington, many attempts are being made to check the tide of deforesting, and to educate the masses to an appreciation of its true bearing on their interests. This is generally attempted by the free circulation of forestry literature in pamphlet form, either directly by the State Legislatures, or through forestry or agricultural associations, which receive State appropriations for that purpose, or even, in a few cases, to private efforts. These pamphlets are issued sometimes, like the present, under the name of reports, sometimes under that of forestry manuals. I have received lately valuable publications of these classes from Ohio, Minnesota, Kansas, Colorado, Illinois, Iowa, Massachusetts, Vermont, and other States. These efforts are not without result wherever exerted. In Kansas hundreds of thousands of acres have been planted with trees, while from most of the States above mentioned encouraging accounts are received. The forestry agitation of late years has not made its appearance before needed. Passing through the older States of the Union, from the great lakes to the southern line, one may travel for days through lands, formerly covered with splendid forests, now so completely cleared that the forest denudation is evidently commencing to tell on the fertility of the soil, as it has in every region where the ever fatal experiment has been tried

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*Ontario's Forestry, Bureau
Annual Report.*

FORESTRY REPORT.

1885.

COMPILED AT THE INSTANCE OF THE GOVERNMENT OF ONTARIO,

BY

R. W. PHIPPS, Toronto.



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1886.

DESCRIPTION OF CONTENTS.

To the Hon. A. M. Ross,

Treasurer and Commissioner of Agriculture.

SIR,—I have the honour to present the Forestry Report for 1885.

It contains in their order :—

Progress of Forestry this year in Ontario, stating several valuable movements made by Government, and otherwise.

Notes of visits made last fall to Massachusetts, Illinois and Kansas, obtaining information as to broadcast sowing of pines, and method of management of walnut and other plantations.

Suggestions concerning Ontario Forestry.

Letters from county clerks and other officials, and prominent residents in Ontario, giving details of Forestry in their vicinity, and their opinions.

Several articles from practical men in Britain and the States, giving statements of the value of different descriptions of wood as crops, and the amount of profit reasonably to be expected in a certain time.

The scientific necessity for care of forests, their uses to agriculture, benefits to climate, and losses suffered where they have been too generally destroyed, by a leading American authority.

A description, State by State, of the amount of forest yet existing in the States of the neighboring Union, and the effect observed of clearing in each ; also showing transfer of industries as timber becomes scarce.

A full account of the value, and methods of growing evergreen wind-breaks, with complete list of evergreens fit for the purpose.

A complete list, so far as obtainable, of every tree native to Ontario, or so long imported as to be well known, giving scientific means of distinguishing each, with glossary of technical terms; also describing soil best suited for, and ways of growing each.

Respectfully,

R. W. PHIPPS.

INTRODUCTION.

No question is more important to North Americans than forest preservation. It has long been said that the nobleman, and the craftsman and the soldier are alike dependent on the farmer, who feeds them all. But the farmer, in his turn, depends on the soil, and on those successions of heat and moisture, without which growth is impossible. Now, we find, by a vast body of evidence, that these conditions are not attainable in anything like so beneficial a degree—that these successions of heat and moisture do not succeed each other in a manner nearly so advantageous to agriculture when too much of the forest has been removed. We all remember the story of the gardener, who, absorbed in the desire to prune, sawed off the bough he sat upon, and broke his neck. Throughout North America, in our eager destruction of the forests there is reason to fear that we are doing something of the same nature. What has been done, and its consequences throughout the United States, a portion of the following report will show, and throughout older Ontario we are moving too rapidly in the same direction. Let me give here one out of many similar opinions. I received last week a letter from a farmer who I know to be a person of sound judgment, and to have followed agriculture in the locality in which he speaks for over thirty years:—"In this part of Ontario, where I have long resided, my opinion a marked effect on the crops can be seen in consequence of the wholesale destruction of timber. Fifteen to twenty years ago, when there were large patches of timber, in crops on new land, or land first plowed after the removal of stumps, we were sure of large crops of grain, often twenty-five and up to thirty-five bushels of wheat per acre. Now, on the same quality of land (that is, new or slightly cropped), we often have very poor crops, seldom more than fifteen bushels per acre. If this difference is not caused by the comparative scarcity of timber, I do not know where to look for the cause." Let me add to this a statement by an Ohio farmer:—"The plainest business principles require that the capital invested should be kept undiminished. The forests were a part of the original capital of our farms in Ohio. There has been reckless waste, and too much of our land has been cleared of its forests. Our climate is more severe in heat and cold, flood and drouth, wind and hurricane, than fifty years ago. I remember when peaches grew yearly in abundance all over Ohio, while now they grow seldom or never, except in a few favoured localities. If we had cleared only sixty or seventy per cent. of the land, and tilled it better, and left at least thirty per cent. in solid forest, we should have been far richer both in cash and climate to-day. In the older parts of Ohio we have scarcely ten per cent. of the land in real solid forest, and it becomes us to study how we may

regain some of the climatic benefits lost with the destruction of the forests. We can gain the climatic effects, without loss of the use of the land. Orchards, sugar camps, roadside trees and cultivated crops like corn and potatoes in rotation with wheat and clover, will together help to break the fierce winds, absorb rain-fall, retard excessive evaporation, equalize temperature, invite seasonable precipitation of rain, and help to prevent drouths, floods and tornadoes. "I have always felt that each farmer ought in some way to do his fair share toward restoring the valuable climatic effects of the forests that have been destroyed. I know that the ownership of land is considered absolute in the United States, and each farmer thinks he has a perfect right to cut down every tree, and not replant. But I could never feel it to be right for each or any to pursue a course that would be harmful or even ruinous if pursued by all; and have regulated my conduct accordingly."

It has been calculated by keen observers of nature, and I have found much evidence to support it, that a country three-fourths cleared and one-fourth in wood will grow more than one all cleared. So far as fall wheat and clover is concerned, the lack of shelter frequently causes the loss of half the crop. Then, the too rapid drying out of the ground by summer winds destroys the good effect of the fertilizing showers, and we think the land is not as fertile as formerly, when it simply needs only shelter to become so. It was formerly said, "cut the woods down, and let the wind dry the wheat, and there will be no more rust." This, however is now found to be a mistake, as where tracts have been almost quite cleared, it is found that there has been, in some years, since the thorough clearing, more rust than ever occurred before. As has been repeatedly stated by the leading thinkers, who have considered the subject, those countries now barren, which formerly were fertile, owe their present sterile condition almost invariably to one cause, namely, that the inhabitants had cut down the woods. The masses of vapor of water which rise from woods must fall again in showers, in showers too, just when vegetation needs them. The woods receive and hold in their deep porous bed much of each heavy fall of rain. It rises and falls in showers. But for the woods it would have flowed over the land at once in a torrent to the next river bed, and carried much fertile surface humus with it, to be wasted in the lakes and oceans. It cannot too frequently be impressed on our minds that a proper proportion of forest in each portion of a country is the great retainer and distributor of that, without which there is no fertility—the moisture which carries all plant food to the roots of plants, raises it to their leaves, exposes it there to the air, draws more food from the air, mingles both, conveys them to their appointed places in the plant, and passes off into the air itself, to perform the same office again. It is the movement of moisture through air and earth, which principally assists all growth; it is the adjacent forest which is the chief regulator of this movement and distributor of its supply, and if we cut down the one, the experience of every nation tells that we greatly injure the other. Over all the prairies, where once they thought their deep rich lands sufficient for everything in agricultural demands, they are now busily planting, for, everywhere there, they consider their great want is trees. I have known one proprietor, there, in one season, to plant a million. The philosophical causes of the action of trees on agriculture are fully explained further on.

FORESTRY REPORT, 1885.

PROGRESS OF FORESTRY THIS YEAR IN ONTARIO.

It affords some encouragement to the advocates of Forestry to observe, that the attempts made to give this subject the prominence which its vital importance demands, have not been unsuccessful, and that the mind of the community is becoming awakened to the fact that due attention to Forestry is necessary to the success of agriculture.

Since the publication of last year's report a very important movement, in the direction of preserving our pine forests, has been made by the Government of Ontario, in offering to lumbermen to pay half the expense of a staff detailed during summer to prevent forest fires, and to make known and enforce the provisions of the fire Act. Many lumbermen at once availed themselves of the offer, and over forty persons have been so employed during the dangerous months of last summer, and there is no doubt, with very great benefit. Throughout the various Provinces and States of North America, there are excellent Forestry Associations, and much that is valuable has been written and said concerning the matter, but Ontario, by the above movement, has acquired the honour of being the first to inaugurate the practical system of forest preservation, and to place a force in the forest to carry it into effect. This action, it may be remembered, was strongly advised in last year's Forestry report.

During the year, an arbor day for the schools of Ontario, has also been instituted, and over thirty thousand trees were planted on its first occurrence. This is likely to have an excellent effect throughout the country generally, as, the tree planting being accompanied by addresses on Forestry to the scholars, practical lessons are then learned by the children, which are likely afterwards to render effective service in the fields and forests of the Province.

During last year the Forestry ^{Branch} ~~Board~~ of the Agricultural Department has distributed eight thousand copies of Reports, and inserted nearly seven hundred articles and letters in Ontario newspapers, nearly two hundred of which journals have thus lent their assistance. Many portions of North America have been visited in search of information, and addresses delivered in many localities in Ontario on the subject.

In many parts of the Province tree-planting is beginning to make some progress, and evidences are apparent, that the efforts which have been made to spread information and give warning on this subject have not been destitute of effect. Much more, however, is to be hoped for in the immediate future. I would specially press three important points

on my readers, trusting that many of them will not allow the summer to go by without giving some practical assistance in this most important work for the prosperity of the Province.

In the first place, it is very necessary, wherever any portion of forest is desired to remain in forest, to keep cattle out. If they are allowed entrance they will eat down all the young trees, when, of course, no fresh trees can replace the old when they die or are cut down. Besides, cattle harden, and render unfit for tree growth the forest bed. If it is necessary, as it often is, to give cattle bush pasture, let them have it where the bush is not intended to remain permanent. Many farmers, understanding this, are now fencing off, with wire fence from tree to tree, such portions of their bush as they wish to retain in forest. Mr. Sargent, the chief Forestry authority in the States, says in his last report, that "all the injury done to the forests of America by the axe or by fire does not equal that perpetrated by browsing animals." Instances of this are described further on.

The next point is, that where the wood is gone or rapidly going from a farm, the owner should consider, whether he could not profitably plant a few acres. This can be cheaply done, as hereafter described, and no investment, in the rapidly approaching scarcity of timber, is likely to prove so valuable.

The third desirable movement is to plant wind-breaks, evergreen if possible. These are fully described, with their methods of planting and care, in pages following. Small trees can be had now, in large quantities, very cheaply indeed. The large dealers of the States sell them at a very low rate per thousand, from four to ten inches long, and these small plants are sent thousands of miles, and succeed well, especially when transplanted twice. Larger trees are dearer. If the demand commence here, I have no doubt our nurserymen can grow seedlings as cheaply. Then in our own woods here and there, are yet many thousands of young evergreens, fit for planting out. The evergreen wind-break is the great need of settled Ontario.

NOTES FROM OTHER COUNTRIES.

From the following notes, taken in Massachusetts, Illinois, and Kansas, much may be valuably learned concerning various methods of Forestry practised there. Those from Massachusetts principally refer to the successful growth of pine forests by merely scattering the seed, those from Kansas give the methods of growing large plantations, and those from Illinois the same, with, also, particular reference to the walnut.

NOTES FROM ILLINOIS.

Here, on the wide, flat prairie, over which the winds blow with an intensity unknown in many parts of Canada, the value of the protection given by trees is acutely realized. "It is hard," said a wealthy proprietor, "to have taken the trouble to plant an orchard, take care of it for some years, and then have it all killed by the frost." "Is it," I asked, "the intensity of the frost or the additional keenness given it by the wind?" "Oh, undoubtedly the wind. Those who have planted windbreaks of other trees, or allowed the Osage orange hedge to grow up to trees along the exposed sides of their orchards,

have not lost their apple trees ; but of those who did not take this precaution, many, last winter being very cold, lost valuable trees. I lost nearly the whole of my young orchard. But the fact is, though a good many forest trees are planted here, we do not plant one in every hundred we should." The same may be said of Ontario.

The prairie is, however, becoming dotted with interspersing groves, though it is plain that much remains to be done. Valuable as such protection is to field and orchard in Canada, it is still more so here, for the Canadian diversified heights and valleys—their succession of hill and dale—allow no such uninterrupted sweep as does the level prairie land. One of these groves is remarkable, and I travelled some distance to see it. It is in Douglas County, not two hundred miles from Chicago, and consists of between two and three thousand large walnut trees, planted in the nut thirty years ago, and now eighty feet in height, and some of them eighteen inches through. This grove—tall, extensive, its pillar-like stems, evenly rising in regular rows of columns, its level, broad table-like summit of autumn foliage—is a picturesque object seen far across the prairies, and affords one of the best instances in America by which to judge the possibilities of walnut culture.

The method pursued in planting has been to set the nuts ten feet apart and gradually thin until the trees are about twenty feet distant from each other, trimming off some of the lower limbs of those left standing, so as to procure tall, straight timber. Some of these are forty-five feet from the ground to the first branch. These trees were for the first four or five years cultivated with crops of corn, but after eight years they cast such shade that nothing else will grow. After about twenty years the ground was, and is now, covered with short wild grass.

But though this grove will, apparently, in another twenty years, yield timber worth many thousands of dollars, and yet leave much standing, which will in another twenty be worth hundreds of thousands of dollars more, yet there are points to be regretted in the method of its management, and some from which we may learn a useful lesson in Ontario. The grove needs a care now it has not lately had, or its existence is in danger. The owner is a man busy with many objects. His herds of thoroughbred and half-bred cattle here are large and very valuable. Cattle, splendid of coat and massive of form, were shown me, for which eight and ten thousand dollars apiece had been refused. He is a busy man on the Chicago Exchange. He has other great farms—acres by the thousand—in Minnesota. Amid these and many other occupations this walnut grove—a plan and hope of his earlier life—has somewhat faded out of view, and the cattle on this home farm have been allowed to use it for shade and shelter. The result is what happens to all assemblages of trees, grove or forest, when cattle are allowed free scope therein.

What we should aim to preserve in perpetuating and increasing a piece of woods is a similar forest bed to that which nature prepares beneath the branches. It is a covering of rich, soft, porous soil below, which perpetually feeds the small rootlets that underlie the ground far as the tree top spreads, and above this soil, and feeding it in turn, a decomposing covering of last year's leaves ; but when cattle are allowed entrance this is impossible of attainment. Their tramping beats the ground hard, a dense, short and not very nutritious grass overspreads it and takes to its own purposes the benefit of the decomposing leaves, which, falling on the ground, should nourish the roots. In this valuable grove in question, the ground is hardened by tramping throughout the whole extent of many acres, and not only this injury has been inflicted, but every tree has been used by cattle as a rubbing post, so that the bark is polished and thinned to their standing

height. Above that, a glance at their bark shows a rougher and much more healthy covering. The process of injury in the grove has not as yet resulted in the death of any of the trees therein ; but coming into the path across the farm, which is bordered by over a hundred and fifty large walnuts, we arrive at a place where the trampling and rubbing has utterly killed twenty-five of these trees, and it needs no forethought to see that the same process continued on the grove will in time be equally effective in injury. The farmer in charge, a relative of the owner, stated that they were aware that the trees were being injured by the cattle, and about planning means to give these shade elsewhere. In the meantime, it appears to me, that had they always been excluded, the trees would have now been ten years' growth the better. The best thing now would be, in addition to keeping cattle out, to cultivate lightly the whole surface, so as to destroy the grass, soften the soil, and give the roots their chance of obtaining nourishment. Here are trees which, with fair nourishment, should, in some years time, yield at least \$50 per tree, or the vast sum of \$75,000. Yet, the desire to improve his cattle has led the owner to allow their injury, and even risk their loss. The same unfortunate mistake is made in many parts of Canada. Fine pieces of woods, which might have continued fit to supply timber in good quantity yearly for ever, have been allowed, in order to give pasture for a few cattle, to become utterly destroyed in forest value, their saplings killed, their soils hardened and grass-covered, and the whole woodland brought into such a state that the owner in a few years cuts down what is left and ploughs the land. The greatest forest authority in the United States has lately written that all that fire has done, all that the axe has done, had not equalled the injury inflicted on the forest by our own browsing animals. This at first sight would appear over-strained, but to those who have considered what the forest value really was and is, how important it is that certain portions of it should be preserved, and that it is those very portions which are being thus destroyed, it bears a different aspect.

In the older districts of Ontario, there should be no great difficulty in growing the walnut to perfection. It grows well near Guelph, one of the highest, and, therefore, most exposed localities in the Province. It was formerly supposed that this tree would not flourish north of the Grand Trunk Railway line, but I have known it to grow and bear fruit abundantly on the shores of the Georgian Bay. Of all trees its planting requires least trouble, for it should be grown from the nut, planted in the fall—or if not then planted, they should be left out of doors in thin layers, covered with sand or litter, when they will be found in good condition for planting in spring. A patch of these—say an acre, or if two acres, all the better—can be planted so as to give shade at any time of the day in two fields, by placing the plantation half in one field, half in the other, and making it, instead of an exact square, a square, each of whose sides are deeply indented in crescent form. There will be then in each field one complete and two half crescents, in one curve or another of which shade will always be found. These curves will also afford the great desideratum of giving shade to cattle without allowing them to enter and destroy the trees, for which purpose, of course, the plots should be fenced. It is to be hoped that this valuable tree will soon be grown largely in Ontario. They give an admirable shade—no better could be desired than that of the Illinois clump I have just described—the walnuts themselves frequently yield a valuable harvest, and the walnut timber is, unfortunately, only too scarce and valuable. The farmer must not expect, however, that in a short time he will be able to cut at pleasure a thick walnut log ; it would be fifty or sixty years before he could obtain the broad walnut boards he sees in old tables to-day ; but he

will have the shade and the shelter, his heirs will have the timber, his farm will be ten times the handsomer for the plantation, and whenever he chooses to sell he will receive full value for it. The loss we have suffered in clearing is well exemplified by the walnut. In Indiana—its former home—I met a farmer who remarked that he had almost cleared his farm from a walnut forest—mostly large trees, three or four feet through. “If I had them to-day,” he said, mournfully, “they would be worth a million dollars; instead, I have a farm worth about five thousand.” There is very little walnut to be had in Indiana now, and that of Ontario, as far as the large trees, yielding good merchantable timber, are concerned, has been for many years almost exhausted. It should be here mentioned that for those who desire a beautiful wood of rapid growth, the cherry will give in thirty years as large a tree as the walnut in sixty, and is quite as easy of cultivation. Ten acres of cherry, with ordinary care for half a dozen years, then left to themselves, would at present timber prices, yield, not improbably, \$100,000, and timber will be much dearer then. What other part of the farm would yield thus?

NOTES FROM MASSACHUSETTS.

There is a quaint charm about these New England villages, here nestling among, there spreading boldly over, the rolling sands which border this Atlantic coast. Wooden houses, large and small, in endless variety, dot hill and dale, interspersed with many an orchard, many a waving grove of pine and oak, many a pleasant road and winding lane, and not a muddy one among them, the sandy sea coast soil is all too dry for that; the rain may fall for three days, and then three hours' sunshine, you may walk where you will dry shod.

There is an air of wealth here, though not of magnificence. There are few farms. Great stretches of common or grove isolate many houses; others in close companionship, yet always retain a generous garden or paddock space around. But of the industries which maintain them or accumulated the fund which now supports them, very few exist here. Sea captains, retired or active, own many; rich city dwellers have erected here many a pleasant residence; here the town-sick summer boarder finds healthy and not expensive retreats; the student may read, row, fish or idle as he lists; and, in fact, of a summer day, a vast and busy population are at work doing nothing in boats, on hills, on beaches, or anywhere they fancy.

The small village of Woodsholl proper is a picture western localities never exhibit. Its brightly painted wooden houses, many, oddly enough, covered with shingles instead of siding, from their strong stone foundations to their eaves; its rolling surface of greensward, where, at every declivity, the wayfarer is aided by steps of massive and time-worn granite that the pilgrims might have laid; its great fresh water ponds for ice (a contrast to our Toronto mud-bounded reservoirs), faced by firm walls of heavy stone; the embowering branches of linden and elm trees overhead on all the roads, sleepily waving in the afternoon breeze; the quietness of all round, as if the sun rose and set ever on placidity alone; and all that interrupted the unvarying stillness was the plash and agitation of the bright sea-waves which roll up into the little harbour gay with pleasure boats, and glitter far away across the sound, through which schooner and steamer, plying between Boston and New York, continually pass, their sails white against the distant sea.

Here, by the way, busy, yet quiet as all the rest, by the shore is the establishment provided by the American Government for hatching the spawn of the cod-fish, and thence re-populating their fast depleting fisheries. Two large buildings, with immense stone vats for the fish while spawning, are provided, and employ a diligent staff of professors and teachers. Farther on, on a common, is a factory where a valuable manure is made by mingling South Carolina phosphate with the refuse fish (menhaden) from which fish oil has been pressed.

All this country round was occupied long ago by the earliest settlers—the men of the *Mayflower* period. This is the “Old Colony” of Massachusetts. This rolling land near the sea was rich, was heavily forested, was cleared, cropped and re-cropped, till its fertility was gone. Long lines of ruinous stone fences, centuries old, recall the period when the soil was worth such careful division. Much of it had long lain idle and barren, the home of a few wandering sheep, in great ranges of wind-swept hills and hollows, with, in sheltered places, some growths of oak and poplar. Just here was peculiarly barren. Twenty-five years since one gentleman, Mr. Fay, began to plant pine trees largely, and still more largely to sow their seed broadcast. Many followed his example, and groves sprung up in all directions. There are now more than ten thousand acres of pine plantations, sown or planted, in this vicinity alone, many of them containing trees forty feet in height.

This planting has greatly sheltered and improved the country, and re-settlement—the influx of the class of residents before mentioned—followed fast on the growth of the trees. In one place I was shown what conclusively proved the case of tree-planting on hills to hold moisture. “This twenty acres,” said one resident, “which, as you see, is high land when treeless, every spring poured down such floods as filled all the deep gullies around. Now that I have had it for years in groves of pines, the moisture is held in the land, and there are no torrents in spring whatever. The water goes, the year round, to nourish the creeks.” The result of planting in this district is, in fact, that while here twenty years ago was little but a succession of bleak and barren hills, there is now such scenery as my first paragraph described. Nor are the planted groves of small extent. One gentleman showed me eighty, another one hundred and twenty acres, in one block each, planted by themselves, of rich pine plantations, the trees being thirty and forty feet in height.

What I want to give my readers an idea of is the way in which this result was secured. Either the seed was sown broadcast on the rough pasture field, or it was sown in the bottom of plough furrows run across the field five feet apart and covered half an inch, or the small pines were taken less than a foot in height and planted with the spade five feet apart each way. These methods have each met with excellent success. The land is a light and rather barren sandy loam, much of the same kind as our poorest Ontario soils. As to the kinds used, they are the Scottish, Austrian, Corsican, and our own native white and red pines. Planting and sowing are each done in early spring.

There is no reason why these methods should not succeed in Ontario. Whoever wants a good plantation along the north or west of his lot, or has anywhere—in gully, or field, or hillside—land which gives little return, could not do better than sow it with pine seed. It is easily obtained, easily sowed, and in a few years the annual thinnings will give all the pine fuel he can use, and sticks for many building purposes besides, while as shelter the trees will be invaluable. Words can hardly tell the difference in climate obtained by a thick pine wood along the north and west of a farm. Of course if

the planter be disposed to purchase young seedlings—which can be had at less than a cent apiece—he saves some years. But many rough places could be much more easily sown than planted.

James H. Bowditch, Esq., gives the following valuable statistics in reference to these plantations :—

It is here we find the native pitch pines (*Pinus Regida*) grown from seed almost as easily as the ordinary garden vegetables, the sandy soil and moist atmosphere favoring its early growth. No old planter on the Cape would think of planting saplings; he invariably sows the seed. Now, where are these plantations, how are they managed, and who are the owners? Let us begin at the end of the Cape and work south.

A five hour ride from Boston on the Old Colony Railroad brings you to North Truro, the next town to Provincetown, at the extreme end of Cape Cod. Near here we find twenty different parties whose plantations cover in the aggregate 562 acres, all planted from seed, and all consisting of the common pitch pines, in the various stages of growth, from 1 inch to 15 or 20 feet. As our object is to know just how these plantations are cultivated artificially, we will explain briefly in detail.

Ten years ago these well-nigh barren and entirely profitless lands could be purchased for twenty-five cents per acre, now, in the same unimproved condition, they are worth in no case less than \$2 per acre; not a very heavy price you may think; but when a man sells by the hundred acres it makes a difference in value received. These broad acres have usually no vegetation whatever, save a light growth of the coarse beach-grass, and, in some localities, the low-spreading poverty-grass, so-called, and a little moss.

In most cases there is no fencing whatever, a fact greatly to the advantage of the planter in his profit account; the division line between different owners being frequently a simple plowed ridge. We now have the land for planting.

Just before the first heavy frost, usually the latter part of October, the seed is gathered in the burrs, balls or cones (thus variously called) from the pitch-pine trees, put up in barrels or boxes, away from mice and squirrels, in a cool place, and before spring they will have mostly opened, when the seeds can easily be taken out. Some people heat them a trifle in the oven to make the seed render a trifle more easily, but it is a dangerous practice, and likely to injure the germinating power.

From one-half to three-quarters of a pound of clean seed is ample to plant an acre of ground. They may be planted at any time in the year, but probably the best time is early spring, as soon as frost is out of the ground. The method now most generally followed, where from ten to fifty acres are to be planted, is to run a plough over the whole track, turning a single medium furrow, the furrows being five or six feet apart. A few planters make the distance apart four feet; a few from eight to ten feet.

The seed is either planted by hand in hills about three feet apart, dropping three or four seed in a place, and just covering it very slightly with earth, with a hand hoe, or a regular seed-planter is used. The latter is probably the easier method, the one most generally practiced, and often quite as successful as the more laborious hand-planting. A boy may follow after and cover any seed left exposed. I find the cost of planting is variously estimated at from \$3 to \$5 per acre. The market value for seed last season on the Cape ranged from \$1.25 to \$1.50 per pound. It takes about a bushel of cones to render a pound of seed. After planting, no further care whatever is given to the area so stocked in most cases. In some places there may be gaps fifty feet long, but these spaces fill up in time of themselves from seeds of the young growing trees. If you hire a team and

drive over the country, a look at the various plantations will abundantly repay an interested observer. A fifteen acre piece with trees about three or four years old, said to belong to Mr. Harvey Collins, seemed very thick and thrifty.

Mr. John Kenricks has tried the following tree seeds, namely:—White and Norway Spruce (*Abies Alba* and *A. excelsa*), White, Austrian, Scotch and Corsican Pines, (*Pinus strobus*, *P. austriaca*, *P. sylvestris* and *P. laricio*). The experiment was made in this wise: A tolerably good soil was well plowed and prepared, and seed planted about one-quarter of an inch deep. The whole was covered with boards at first, raised slightly when the seeds sprouted. The White and Norway Spruce and White Pine seeds scarcely germinated at all. The others germinated and grew well, where planted in cultivated land or nursery rows. When planted in furrows or hills in sward land, they suffered from drought, and made but slight growth. Probably not over twenty-one per cent. of the hills are now standing. The Scotch pine did somewhat the best.

In this method of planting forests, whether by broadcast or furrow sowing, it is necessary of course, in order to cover the ground, at first to raise far more trees than are ultimately needed, and it has been long a disputed question whether it is best to let a young forest thin itself, the stronger trees killing out the weaker, or whether, after a time, to thin out artificially.

Some gentlemen here are of opinion that it is better to thin by hand. In support of this opinion an interesting illustration is given by the Hon. Levi Bartlett, of New Hampshire. In that State a tract had been cleared and burned over in a very dry season, about the year 1800. It immediately seeded itself with White and Norway Pines, and about twenty-five years after came into his possession. He at once thinned out the growth on about two acres, taking over half the number of the smallest trees, the fuel much more than paying the expenses of clearing off. From that time nothing was done with the lot for the next twenty-five years—having sold it, however, during that time. Upon examining it he found that, by a careful estimate, the lot which had been thinned was worth at least a third more per acre than the rest which had been left. It was worth at that time at least \$100 per acre. He thought that had the land been judiciously thinned yearly, enough would have been obtained to have paid the taxes and interest on the purchase, above the cost of cutting and drawing out, besides bringing the whole tract up to the value of the two acres which had been thinned out.

At the time when this part was thinned, twenty-five years from the seed, he took a few of the tallest, about eight inches on the stump, and forty to fifty feet high, and hewed them on one side for rafters for a shed. At the next twenty-five years, fifty from the seed, he and the owner estimated that the trees left on the two acres would average six or eight feet apart. They were mostly ^{or Spruces} ~~Norwood Pines~~, ten to twenty inches in diameter, and eighty to a hundred feet high. He was greatly surprised, seven or eight years after, to see the increase of growth, especially the two acres thinned thirty years before. The owner had done nothing, except occasionally cutting a few dead trees. It was now the opinion of both that the portion thinned out was worth twice as much as the other; not, however, that there was twice the amount of wood on the thinned portion, but from the extra size and length of the trees and their enhanced value for boards, logs and timber. There were hundreds of Norway and White Pines that could be hewn or sawed into square timber, from forty to fifty feet in length, suitable for the frames of large houses, barns and other buildings. There were some dead trees on the two acres thinned at an early day, but they were only small trees shaded out by the large ones. On the part left

to nature's thinning, there was a vastly greater number of dead trees, many of them fallen and nearly worthless. Of the dead trees standing cords might be cut, well dried, and excellent for fuel. Estimates were made that this woodland would yield 350 cords of wood, or about 150,000 feet of lumber per acre. Allowing that these were too large, the real amount must have brought a very large profit on the investment.

The opinion of leading planters of trees here of sowing or furrow is that, though not so successful with these, owing to the strong sea gales, as the pitch and Scotch pine, yet that the white or red pine would grow well from seed, by either method, in Ontario. As before remarked, there is much land in Ontario, side hills, waste sandy plains, burnt lands, and so on, where, if successful, the experiment would prove most valuable. If the ground be such as to receive the seeds—that is, not a sod or hard clay—broadcast will do; if harder, a furrow is easily made. The shade of surrounding weeds, if not too dense, will not injure—a partial shade, in fact, is always beneficial. Wherever the pine trees are being cut down the large cones could be easily gathered, and put away till spring in a dry place, secure from mice, when the seeds will easily drop out. There is no reason why this should not be done over much land, useless now, but which would then, for shelter and ultimate wood, be very valuable.

NOTES FROM KANSAS.

Arriving at length at Kansas City, after two days and nights of rapid travel from Toronto, yet another train carries us forward across the Kansas prairies to Fort Scott, an old military post—for this region lay along the Indian border, and still there are large Indian reserves near at hand—now a thriving city. The scene all day is a succession of rolling prairies, with occasional stretches of forest, where rivers pass through the lower land. All but the red oak leaves have left the trees, and the far-spreading plains, across which here and there we can see to points forty miles away, give one unvarying ground of autumn brown, save where a field of black prairie earth has been inverted by the plough. Every green tint of spring and summer is gone, but the air seems yet as warm as that of a July day.

When one sees here on every side the scarcity of wood and the economy of its use, the three-inch posts which often supports the fence wires, the cattle sheds built of poles and roughly thatched with straw, the great bins of yellow corn formed of poles as well, and apparently destitute of any roof save what hurried hands might extemporize from heaps of cornstalks should rain occur; the barns few and far between, and built of timber of the slightest, one can appreciate the difference between this and a forested country. They have indeed many pretty wooden houses, but the lumber comes far by railway and costs much. There is no difficulty, however, as to fuel, for vast deposits of bituminous coal underlie the region, and one sees it at every door heaped in black piles seamed with reddish brown. It is delivered generally here at \$2.50 per ton. Ontario farmers, living in a country destitute of coal, are only too likely, at no distant day, to remember regretfully their vanished wood lots.

The cost of wood is, generally in its carriage. It is small consolation to the Kansas prairie cultivator to know that other States have timber to spare, and that even part of his own is a wooded land. Come from whence it may, it is dear when it reaches his

immediate locality. One railway board here, recognizing the fact, and knowing that the growth of wood when set about in earnest, is neither a slow nor difficult task, has established in Kansas the largest artificial plantation of forest trees in North America. These railway gentlemen themselves gave out the contract for planting over a square mile of land with young saplings of the catalpa and ailanthus; and their president, observing the success of their experiment, and impressed with its probable excellent financial results, has had planted, at his own expense on speculation, as much more. These are situated near the little town of Farlington, Kansas, where we stop over night, see the manager, and make arrangements for visiting the youthful forests in the morning.

These plantations, now bare of leaves, stretch far over the undulating prairie, in full view of the town. In summer their wide-spread surface of broad leaved and pale green foliage forms one of the most beautiful sights of all this country. At proper intervals carriage roads are left through them, and as it is a few days' drive to examine them well, we obtain a carriage and horses and commence our observations. The different sections have been planted, it appears, respectively, two, four and six years ago. About one-fourth is planted with the ailanthus, the rest with catalpa, and a few, perhaps a thousand, trees of white ash. Those first planted are now 25 feet in height, the last about twelve. Some of the taller are seven inches through the stem. The first seedlings were brought from Illinois by the car-load—the rest grown in seed-beds here. There are in all about three millions of trees in full growing vigour on these plantations, this calculation leaving out a few on some small portions of poor land, which are not flourishing so well, but will yet be good trees in time. All were planted four feet apart each way to shade the ground, but eight feet is the ultimate intention, which will allow three-fourths of the trees to be cut out, a thing which can be well done when they are fit for fence posts, say seven to nine inches through; or, if required, they can stay even longer without injuring the plantation. When rather larger it is expected the trees will give excellent railroad ties, and at their fuller growth of fifteen or twenty years, they will supply valuable timber for cabinet work and house building.

Those who have only seen the original forest, with its trees growing hap-hazard here and there, little ones and big, have but a very vague idea of the large amount of wood these closely planted groves can spare in their process of growth. This process, partly natural, is also by the art of the planter rendered partly mechanical. Extensive masses of young trees planted in this manner are restricted to but one method of advancement—the endeavour to throw out masses of leaves to the light and air of the upper surface. The lower branches hidden in shade rapidly die and fall to the ground, and the plantation becomes a multitude of long straight stems full of life and vigor, but only spreading into branch and foliage at the summit. If a tree in youth be crooked it straightens itself if thus surrounded as it advances in height. One acre so growing will give of wood, which is all the better taken, quite a number of cords yearly, till all the superfluous trees are gone. On each acre here are two thousand more trees planted than will ultimately be allowed to attain full growth. There will be left perhaps nine hundred thousand to come to maturity, and as these, as well as being very useful timber, are fast-growing trees, the profits seem likely to be very large.

It is a matter to be considered with our land-owners and capitalists, especially those who have properties they wish permanently to improve, whether to follow in Canada the example of these tree-planters in Kansas and the Western States would not be the most

remunerative investment they could find. It is but a day's journey from these plantations to heavily wooded countries—the forests of Indiana soon rise, dark and close, beside the railway—yet it is thought the most profitable way of investing many thousand dollars, to plant these square miles of closely standing trees. Many of these are already six or eight inches through in six years, and would, for instance, very soon make two railway ties to the tree. This is an item of use which is drawing largely on the wood resources of the country. In the States there are not less than sixty millions of railway ties used yearly, and as these are taken from vigorous and healthy young trees, which will give about two ties each, it means the annual destruction of thirty millions of such—a serious drain on the forests. For this purpose it is, as I have pointed out, being thought so much cheaper to grow than to buy elsewhere and transport to the place where needed, that large amounts of money are being spent in planting. Considering the great value of sheltering plantations, and the vast quantity of timber which can be rapidly grown in them—very much more than can be expected from any natural young forest—I must press on my readers the advisability of planting a few acres along the north of their farms. Trees will be found to grow very much better in plantations than in lines. One tree draws another up; and besides, a number of young trees cover the ground with shade, and keep the earth in that moist, warm, rich state favourable for the expansion of the young roots. Then consider how slight the cost. Two thousand trees will plant an acre, and can be got for a small sum besides freight, &c. The land once in good condition, (such as you would give it for wheat, if fair land, will do well enough) a couple of men will plant an acre in two days, or three if unused to the work, after which, with cultivating once a year for three years, the trees may be left to themselves. I have sketched out here, the rapid, cheap way of planting. Of course, with more care, preparing the soil better, repeated ploughings or harrowings, and perhaps the choice of larger trees from the forest or elsewhere, much greater results may be expected; but the cost will be very much greater, and, as the experiments I have detailed will show you, the cheap way does very well. In the sea-side experiments as shown above, the seed is merely sown broadcast or roughly furrowed in, and a thick and thriving forest results. In the Illinois walnut plantings nothing more was done, than to plant the nuts with another crop, and in after years to steer the plough clear of the trees. In this detailed above, in Kansas, the new prairie is broken and spring ploughed and harrowed, and the young plants put in by two men, one digging the hole, the other placing a plant in position, while the first throws a spadeful of earth against it and stamps it firm with his foot. The plants are merely seedlings direct from the seed bed, never having been transplanted. They will plant a thousand a day. All is done with a view to plant much land cheaply, and the trees invariably have succeeded well, except where the poorest and hardest part of the land occurs on the slight eminences. Even here, though the trees are of slower growth, yet they are alive and growing, and will be good-sized trees in time. Any Ontario farmer, working in the same way, can cheaply give his farm as much of grove as he may desire.

In doing this it is well to remember that it is not all for shelter, nor all as fuel, that we plant the grove. In the near future, is coming a time when many of the sticks from our plantations will be most valuable for many purposes. For instance, if we plant a grove of hickory, which merely needs sowing the nuts. It has been said by a leading authority in this country, whose factory uses much of the article, that one hundred acres of it in second growth would be worth more than many whole townships which now yield good

crops but seldom. It can be used from six inches upwards. This can be well grown here. I knew twenty acres of fine trees—many of them a foot through—grown on a sandy loam near Toronto. With care, but a few years would elapse before some thousands of six, seven, and eight inch stems were produced by the method above described of close planting. At present, our principal stock of such wood has to be brought from Ohio. Let us calculate what could be done with hickory. These plantation trees described above, were already, in places, of six or eight inch stems, and would well give them twenty feet high before thinning more than one half out. There would then be 1300 trees left. Suppose by losses, or thinning again one-half in the rows, we had 650 hickories left. These, as soon as they could square eight inches, would yield a hundred feet, or 65,000 ft. in the acre. At present prices this would bring \$6,500. It must not be expected that hickories would grow as fast as the soft woods—for instance, the silver poplar, which I have known give three feet four inches diameter in twenty years,—nor have we, unfortunately, instances of close planted groves which would tell us how soon to expect the size calculated from. But we may be sure they would grow very much faster than the scattered hickories here and there in our fields, and that the farm they were growing on would be in a few years, very valuable from the known profit of the expected crop.

NOTES FROM WAUKEGAN.

Passing from Chicago, thirty miles to the north, we reach Waukegan, the home of the leading tree-planter in North America, whose trees I have found growing by the thousand on the distant Atlantic coast, in the far south, and over the western prairie. I think of all localities I have visited, trees seem to flourish here the best. It is not the soil, for that is evidently but poor and sandy. It may be that the atmosphere,—from which in fact, trees derive most of their nourishment—is the cause. Here on the shores of Lake Michigan, exposed to the full force of the eastern winds, the lake breezes meet and mingle with the air of the prairies. Whatever the cause, the maple foliage, now autumn reddened, stands from the tree with a bolder and a wider spread—the pine and cedar are of richer green—than I have seen elsewhere.

Here, on the extensive grounds of Mr. Douglas, are great masses of closely-standing young pines, spruces and larch, acres in extent, illustrating the principle on which he has commenced, throughout the States, many large and thriving plantations. Let me first state the object for which trees cultivated in this manner are planted:—(1) To grow wood more rapidly than any other process will give it. (2) To grow that wood in straight beams. (3) To obtain much more wood in the same ground than an equal space in the forest would give. (4) To create such a plantation as will, in exposed situations, act as a complete and impervious shelter, and will give dense shade on every side, so as to benefit cattle, without the necessity of allowing them to enter and injure it. (5) To create one which will also act as a reservoir of moisture, preventing rain from passing too rapidly away, and giving it out gradually by feeding springs and otherwise—a most valuable quality, especially where the plantation can be located on the higher portion of the farms. (6) To plant so that the trees will never need pruning, but will prune themselves, so that after two or three years no cultivation will be necessary and no weeds appear.

All this is secured by planting trees not more than four feet apart each way. For two or three years they are cultivated to destroy weeds, and after that the depth of

shade they cast prevents further growth. This great mass of trees then growing up closely together, presents always on the upper surface of the grove, a succession of bright green-leaved, and healthy tree tops, while inside the grove their appearance will be very different. There will here, especially in the case of evergreens, be many decaying and falling branches. In fact, the shade will kill off all branches but the upper ones. As the grove gets taller, and the trees larger, there will be too many trees and the weakest of these will, in turn, be killed by the strongest depriving them of light and air, till the proper number of trees is left on the ground.

Nothing need be done so far to assist nature. But if the trees have been properly selected, this process of crowding can be made convenient to the uses of the owner of the plantation. If every here and there among the trees, at proper distances, have been planted such as are of slower growth, the quicker growing can be taken out as they mature, and those of slower growth left to continue the grove; or those whose timber is most valuable can be left, those least valuable removed. For instance, say we take the black walnut, (where it will grow) ash, cherry, and yellow birch, all of which are very valuable timber. Plant them eight by eight feet apart. Let us then take maples—soft maple or sugar maple—and box-elder, and fill up till all is planted four by four feet apart. Planted all together they will soon cover and shade the ground, will all grow up together to a dense grove, and will, when the maples and elders are taken out (doing which will give a great deal of timber), leave room for the more valuable trees, which in their turn will be taken out when mature. For instance, you will get the cherry in half the time you would have to wait for the black walnut. Evergreen and larches are planted the same distance apart, but plantations of these are better by themselves. Plantations of this nature will fulfil the previous description.

When the ground is well prepared, and mellow, they can be planted easily and rapidly, and by persons who have had no previous experience. Two men generally perform the planting, or a man and a boy; the latter holding a bundle of young trees under his arm, takes one and stands it in place, when the other has opened the ground for it by removing one spadeful of earth. This is then placed again in the cavity, against the root, which is held by the other firmly against the back of the opening. The earth is now pressed against the root with the foot and the tree is planted. Very few fail to take root. The trees are of course small, from one to two feet high, but being grown in nursery beds have generally good roots. Two people plant nearly a thousand a day. The cost of these young trees is small, in large quantities—say twelve thousand—they are quoted here, most of the varieties mentioned, mixed, at a very low rate per thousand, and I have no doubt that if a large demand existed, they would also be cheaply obtained in Canada—perhaps can now. In a few years no part of our farm will pay so well as some acres so planted, counting wood alone. It is surprising how many cords of wood in mere cullings, can be taken from a small plantation, while in yielding shelter, and improving the adjacent soil by its retention and distribution of moisture, the advantages would be very great.

SUGGESTIONS FOR GOVERNMENT ASSISTANCE IN PROCURING YOUNG TREES.

A method I should suggest, which would give, I should conceive, a considerable impetus to tree-planting in Ontario, would be as follows: Small seedlings, such as are used for planting tree claims in the Western States, are procurable at a very low price,

when large quantities are taken, namely, \$25 for thirteen thousand, or enough for five acres. If the trees were supplied free of cost, for say thirty plantations of five acres each, it would probably be easy to find, throughout Ontario, as many individuals willing to devote five acres each to the purpose, to plant them, and to take necessary care of the trees, that is to say, they should be planted four feet apart, each way, well fenced from cattle, and have the soil worked with the cultivator for three years, sufficiently to keep down weeds, after which the young trees would shade the ground and take care of themselves. I should recommend for this purpose, as suited for the soil and climate of Ontario, white ash, white pine, cherry and larch, about one-fourth in each plantation, the other three-fourths to be of the ash-leaved maple, a cheap tree of easy growth, and answering well to shade the ground to be planted, so as to be cut out for fuel and other purposes, leaving the four first named trees ultimately in possession of the ground to grow to maturity.

These could be got, procuring a rather larger and better description of trees than those used as above described, and therefore the fitter for our purpose, delivered in Toronto, at about \$45 per plantation. I am not aware of any nursery in Ontario growing seedlings in such quantities as to be able to dispose of them so cheaply, but of course, if possible, it would be better to obtain them here. The impetus of the example once given, it is probable that many other people would be willing to purchase trees and start plantations for themselves, and our nurserymen would soon, if they are not at present, be in a position to supply young trees more cheaply than they can be imported. There is no difficulty in raising them. In fact any farmer, who considers that he has two or three years to spare before he needs such seedlings, could raise them from seed for himself.

At some meetings, many of which have been addressed during the year on the subject, farmers have suggested that, while the present tree planting Act has served a valuable purpose, it might be improved by the substitution of evergreens for the present deciduous trees mentioned therein, which would encourage winter as well as summer shelter.

SUGGESTIONS CONCERNING PINE LANDS.

Since the great step in advance has been made by the Ontario Government, in conjunction with lumbermen, of organizing a forest police to guard against fire, the way is open to recommend some other measures which would have been comparatively useless before. For instance, it would be well that an arrangement were made, by which no pine tree under fifteen inches in diameter should be cut. Previously to the comparative security against fire, now given by the fire police referred to above, it was not so possible to leave trees of this size to grow, for at any moment fire might destroy them. Under the present arrangement much greater security against fire will exist, and it would therefore be advisable to leave trees under this size uncut.

After consultation with many lumbermen, and visits to many forests, I am unable to recommend any method of disposing of the *debris* of pine trees left by the lumbermen, as there seems no way except that of piling and burning, which would add very much to the cost of lumbering.

It is possible, however, without going to this expense, to do one or two things, which will greatly decrease the risk of fire. The branches of all heads of trees left might easily be chopped so as to fall to the ground, and all brush, young trees, etc., which had been

cut down, given one or two axe strokes with the view of making them lie near the ground. Needles and branches on the earth dampen and rot. Raised above it, they dry into dangerous tinder.

Another method of avoiding *debris*, and a most important one, would be the discouragement of getting out square timber, and the encouragement of taking out the whole log. It is the chips of squaring timber, and the many logs chopped into to test them, found unfit, and left lying, which form the most dangerous material for fires.

With regard to that most important point of setting aside reserves of forest, there is, in older Ontario, no place which can be recommended except that, in and near the County of Renfrew, mentioned in last year's report, because it is the point of head-water of so many streams. It has been suggested, lately, by persons well acquainted with the country, that some additional townships adjoining might well be added, as it would cover more sources of streams running into Georgian Bay and Lake Ontario, and the addition proposed is land in an equally wild state. To carry out the object of a reserve, it would be necessary to prohibit settlement in its bounds, and to sell only trees whose age demands that they be cut down. It would be necessary that one or more persons should be placed in charge of such a reserve, to keep off trespassers, choose timber for sale, and prevent fires. A reserve at this point would preserve the rivers flowing to the Ottawa, and likewise those flowing towards Georgian Bay and Lake Ontario, and benefit greatly all the farming country on their route. There are, no doubt, portions of the unsettled new country north of Huron and Nipissing, where reserves might be valuable, but I have not yet been able to examine them. The one referred to is of far more immediate necessity, as tending to preserve in fertility a large portion of settled Ontario, and to prevent violent inundations in spring throughout that part of the country.

FORESTRY IN ONTARIO.

The following letters, either from the county clerks, or gentlemen, whom, as better acquainted with Forestry, they deputed to answer for them, describe the state of affairs, as far as tree planting and effects of deforesting are concerned, in and near their different counties. The questions asked will be easily gathered from their answers. If the reader will take the trouble to go through these letters, he will obtain many valuable ideas on Forestry, as applied in these localities, from gentlemen who have very great local and often general knowledge of that of which they write. The answers as yet received are from sixteen counties, so dispersed as to give an excellent general idea of Ontario Forestry :

STORMONT, DUNDAS AND GLENGARRY.

MORRISBURG. I have before me your favour of yesterday inquiring: 1st. Is tree planting making any progress in this county? 2nd. Have trees been planted for wind-breaks. 3rd. What trees? 4th, What injury to the climate has been observed when the country has been deprived of shelter? 5th. Is travelling more difficult on account of drifts? 6th. Is stock less easily kept during the colder months? 7th. Is the snow blown off the fields to the injury of the crops?

My reply is—1st. Tree planting for shade to houses and lanes is making increasing, but slow progress, and is as nothing compared with the rate at which the woods are being cut down. 2nd. I have not heard of any for fields, but there are a few for orchards. 3rd. Hard and soft maple, elm and spruce. 4th. I have not information

that would make a reply of value. 5th. Yes, much, there is a beginning of an attempt to help it by making wire fences at joint expenses of township and owners of lands along leading roads. 6th. Stock is almost universally housed during the colder months, and would not be left out-doors, no matter how much woods there might be. 7th. There is little winter grain raised in these counties. I have not heard that it is more difficult than formerly.

There is nothing connected with our country that saddens me more, than the wicked waste of the forest, and the prospect of a vast bare plain where the winter winds cut to the quick, and for want of fuel and shelter there will not be place for poor men, except as menials in the houses of the well-to-do. I do not think all the good work done in Ontario during the last forty years would be nearly equal to the evil of disforestation the destruction of the stored-up wealth for ages. On account of the minute division of land, the narrow circumstances of the proprietors, and the equal division of property at the owner's death, I have little hope from individual work; it must, I think, be a Government movement. I have observed, sir, that you are doing a good work in awakening and enlightening public opinion. In these counties, I am sorry to say, it has not been awakened yet.

N. MCKENZIE, Warden.

LOCHGARRY.—In reply to your kind letter of the 26th, would say:—The object to which you are devoting yourself is of such importance to the future of our country, that every exertion should be made to bring it prominently before the present generation, as I have no doubt that the fruitfulness of our country largely depends on the climatic influence of the forests, on the fertility of the soil in causing rain and moisture to our fields, and I trust you may long be spared to use your pen and influence in favour of forestry.

The front of the County of Glengarry has been largely denuded of its primeval forests, the centre and rear portions are pretty well wooded, as the most of our farmers during the winter months keep their stock well stabled. Cattle do not suffer to any great extent from the want of forest shelter during the winter months, but in the summer they suffer more for the want of the shade trees.

I have no doubt that the want of trees around our fall wheat fields has a very injurious effect on the growth of fall wheat, the snow blowing off the fields, and accumulating around the fences, causing the wheat to rot near the fences, and to be killed in the centre of the fields for want of covering, which has so much discouraged our farmers that very few of them attempt to raise fall wheat.

Our public roads running north and south, are, during the winter seasons, almost impassable with the depths of snow that drift on them in the clearings, the roads generally having high fences in the clearings which retains the snow, which causes a great deal of labour very grudgingly given sometimes. I have observed that, wherever there were green trees, such as spruce or cedar, growing inside the fences, the roads never drifted up. If our farmers and others would be induced to try the experiment of planting green trees along the roads that were exposed to drifting of snow, they would see the benefit of it, and save themselves the annoyance of having the winter roads passing through their fields, and very often breaking down their fences. There is very little done in this County in tree planting, except as shade trees around dwelling-houses, which is very extensively done.

JAMES FRASER.

DUNDAS.

IROQUOIS. Yours of the 23rd "*Re Tree Planting*" received. Tree planting is making some progress here, but it is as yet principally confined to lines of trees along the roads, and about the buildings. A few orchards have belts to the north and west of them, and a very few "sugar orchards" have been planted. Where lines of trees are planted for shelter, the spruce, balsam, and white cedar are used. The "double spruce," is a favourite where it can be obtained conveniently, both as an ornamental and screen tree. The single spruce, or balsam is usually where the other cannot be got. The cedar is a favourite

about yards for hedges, and is also used for screens for orchards, etc. I think the cedar is one of the best trees we have for this purpose; it is not so dense in foliage as the "double spruce," but the limbs are less liable to die about the trunk of the tree, and the tree less liable to be broken by weight of snow or wind.

The trees most used for planting along the roads and fences are the hard and soft maple; the first on dry soils, the latter on lower places—its natural home.

Travelling in winter has become infinitely more difficult. It has become impossible to keep fenced roads open at all in severe weather, and the travelling is mostly done through the fields. To obviate this, in this Township we are building wire fences along the principal roads, and where they are not built, laying down the fences in the fall, to be put up in the spring.

The blowing of the snow off the fields, and the piling it in banks by the fences, have made fall wheat culture very precarious. While this country was a bush dotted with clearings, fall and winter wheat was a very certain crop; since it has become an open country, dotted with a few groves, it is very uncertain, not because it does not yield well, but because the centres of the fields are frozen out, while the sides are frequently smothered under the banks. Another local effect of the absence of forest lands here is the spring freshet, and an occasional summer freshet which are frequently very destructive.

The most of this country occupied a basin between the St. Lawrence and Ottawa Rivers, that finds its outlet through a small stream to the Ottawa, near Plantagenet, about seventy miles to the north-east. The rapid melting of the snows in the spring, floods the country for miles on either side of the stream in this county, and the high winds that sweep the surface, since the forests have been removed, raise large waves that carry fences and everything movable before them. In the summer the crops are frequently destroyed by sudden freshets.

I think that every effort to encourage tree planting should be encouraged. We have a little of the "forest primeval" yet, but is diminishing every year. Some second growth groves are being preserved, and many of our roads will soon be lined with trees. Our land is mostly good just here, but we have some stoney ridges running north and south, or rather north-east, and south-west. These should be replanted, and retained as forest. They would be as productive, or more so as forest as they are as farm lands. They would screen the valleys, and would add vastly to the beauty of the country. Maple, hard and soft, elm and ash would probably be the best trees for culture.

A. HARKNESS.

MIDDLESEX.

LONDON. Your letter dated a month ago was duly received (in reference to the preservation of forests.) I read your letter to parties that came into my office on business. Some agreed with me that the country would yet suffer by the forests being cleared off. I do not think the people yet understand it, or they would be planting belts of wind breaks. There is just one thing some are doing; they are fencing the cattle out of the woods to let the young stuff grow up, which it will do in a very short time if protected, and it will help to save the old timber that is still alive by keeping, or breaking off the gales of wind. I think a few farmers doing this, will cause others to do the same. It would not cost much to fence in eight or ten acres on two sides with barbed wire. The great trouble is to get the people to find out before it is too late, that portions of the natural forests should be fenced. In my neighbourhood, about five miles from London, some farmers have cut their last tree off their one hundred acres, in some instances, have hardly left a shade tree. I have spoken to several that they were doing wrong in clearing up the whole farm; they say they can make a great deal more off the land than the wood will ever be worth. There are very few lines of trees planted to any great extent as wind-breaks, only occasionally a farmer plants a row of trees down his lane, or some such.

D. G. MACKENZIE.

HALDIMAND.

DUNVILLE. I am in receipt of your letter of the 15th, in reference to "Tree-planting, and Preservation of our Forests," and to the several questions asked, send you my answers as follows:

I have never heard of any tree-planting in this county, and believe there has been none. I think very little of the old forest is likely to be permanent in this county.

I have never heard, nor do I think that any wind-breaks have been planted. Where cattle and other farm stock have been deprived of shelter, they are less easily kept during the colder months. Travelling is more difficult on account of drifting snow, and crops are injured by the snow being blown off the fields.

F. STEVENSON.

LEEDS AND GRENVILLE.

BROCKVILLE. I do not think that tree-planting is at all satisfactorily progressing in these counties, and I have no precise knowledge on the subject, but some planting has been done on Arbor Day, and individual farmers have planted fewer or more trees without systematised effort as to any plantation, the ground not being set apart for that purpose, I infer.

JAMES REYNOLDS.

WELLINGTON.

FERGUS.—Tree planting, except for ornament, has made very little progress in this neighbourhood. The remains of the forest still in existence are carefully preserved, but chiefly with the view of getting a good high price for fuel. So few plantations have been made, even for wind-breaks, that little can be said with regard to their effect on crops. The various species of spruce and balsam-fir are the trees generally planted for shelter. I consider the climate has been very injuriously affected by clearing off the forests, as we are far more exposed to sweeping winds, which strip the large, open fields quite bare, and make great drifts in the roads. If it were not for the railroads, travelling would be almost impossible many times every winter. The stock are generally carefully housed up after November, so it does not affect them so much. Many of our little rivulets are dried up on account of the clearing away the forest altogether.

A. D. FERRIER.

ELGIN.

ST. THOMAS.—I am not in possession of such full information as you ask for, but can inform you that the Public School Inspector reported that on Arbor day 1,100 shade and ornament trees were planted in the school grounds of the county.

K. W. MCKAY.

VICTORIA.

LINDSAY.—In accordance with a resolution of the County Council of the county of Victoria, at its session last week, your letter addressed to the Clerk of that body, has been handed to me for reply. In compliance with which, I will answer your questions in the order in which they are given.

1st. "What progress is made in tree planting in your county?"

There has been no progress of importance made in tree planting outside the town of Lindsay. Here, a great deal has been done in planting shade trees in many of our streets, most of which in the summer time present a very respectable appearance. This work, however, has been done by a few persons only, with an expenditure of perseverance and energy deserving much greater success. Cattle of all kinds are allowed to roam at large in this town, consequently the number of trees now growing—although a very large number, and which may be considered to be beyond danger from this cause, is perhaps not more than one or two per cent. of the whole number planted. In private

gardens much progress has been made in this way, and large numbers of very fine specimens of timber trees, as well as ornamental trees and shrubs may be seen. The Roman Catholic school authorities have done good work in their school grounds, thanks to the late Father Stafford, who inaugurated the work, and to the succeeding School Boards who have continued the same with some success to the present time. The Public School ground on the other hand, which are on a much larger scale, is little better as yet, than a barren waste. Wiser councils have prevailed lately, and I am pleased to add, that preparations are being made for great improvement at an early date. Outside this, the county town, a few shade trees may be seen in or near some of these villages, but I am not aware of anything having been done, worth speaking of, by the farming public.

2nd. Have wind breaks been planted, of what are they formed, and what effect have they had on the crops ?

I do not know of anything of that kind having been done by any of the farmers in this county, not because there is no need of wind-breaks, but because farmers have no practical knowledge of the benefit derivable therefrom to both crops and cattle.

3rd. What injurious effects has clearing the forests had on the country ?

But little, if any injurious effect has yet been observed from this cause, that I am aware of, for this reason, that a much larger percentage of woods remain standing in this vicinity than in the front counties, and also because of the proximity of the almost unbroken forest at no great distance to the north of us.

4th. Is stock so easily kept as formerly, during the colder months ?

Cattle are generally much better provided for now than formerly, and the more prosperous and enterprising of our farmers, are rapidly introducing the best breeds of stock of all kinds, and for which the best of accommodation is being provided. Therefore the loss of protection is very little felt.

5th. Is travelling more difficult in winter, because of snow-drifts, and is the snow blown off the fields to the injury of the crops ?

Much inconvenience and sometimes heavy loss is sustained by the travelling public, because of snow-drifts blocking the roads, and great injury and annoyance is felt by the farmers, occasioned by the travellers destroying their fences and making a highway through their fields, and especially through fields of fall wheat, when towards spring, there is little or no snow on such fields, while the roads yet remain impassable. The fact, that a common rail fence will often be the cause of a road becoming so snow-drifted as to be almost impassable should prove to the farmers how easily snow might be obtained on his fields by a well-divided system of wind-breaks.

From the foregoing, you will perceive that there is a fine field here for the growth of information on the subject of Forestry. The whole neighbourhood is—I may say—virgin soil in respect to this subject, and it is not now too late.

THOMAS BEALL.

PRESCOTT AND RUSSELL.

L'ORIGINAL.—Your communication of the 15th, addressed to John Fraser, Esquire, has been referred to me, with the request that I should acknowledge the receipt and reply thereto. The united counties of Prescott and Russell are peculiarly situated in relation to Forestry by their geographical position, by climate, by character of soil, and the kind of trees and modes of planting, and cultivation suited to this section, may be wholly unsuited to the more easterly and southerly portions of Ontario.

These counties lie along the base of the Laurentian range of mountains, where the forest primitive or secondary almost wholly prevails, and which, with its numerous lakes and rivers must have considerable effect upon the humidity and temperature of the sections of table lands lying along their base.

The prevailing lands in their primitive state, were cedar, tamarac and spruce swamps, interspersed with occasional blueberry marshes, the sub-soil of which was, and is, a bluish clay, with a surface soil diversified by sandy and clay loams, vegetable and other moulds, and large sections of black muck of considerable depth, some almost verging on peat bogs.

There were sections of considerable extent of high, rolling, hardwood lands above the limestone strata, on which the timber was maple, elm, beech, larch, basswood, some pine and other varieties. These lands were the first settled upon, and a reasonable portion of forest thereon has been preserved. On the swamp land as settlement progressed and burnings for purposes of clearance were started, the fires extended far and wide, beyond the intention of the settlers starting them, whereby large tracts of country were denuded of the forest, which was not then considered a curse, but rather a blessing, as they were at once broken up and settled upon. The result has been that two-thirds of the land of the counties, that a few years ago was an uninhabitable region, is now converted into valuable farming lands inhabited by thriving industrious farmers.

In fact the primitive forests on large tracts of swamp lands, cannot be preserved where settlement makes any progress; for fires, at seasons when the wood will burn, are essential to clearing the land, and these fires when once started, become oftentimes uncontrollable, and spread until stayed by rains or change of soil and timber intervenes. The result is, on our low lying (swamp) lands there is a great deficiency of forest. The lands are settled mostly by French Canadians, whose lives having been spent in subduing the forest, look upon a standing tree almost as a natural enemy, if not to be cut down, to be allowed to die a natural death.

On our rolling land, there remains a fair proportion of forest and ornamental shade trees, that are carefully preserved; on the low flat lands there is a deficiency. In the Province of Quebec, under the leadership of the Hon. Mr. Joly, quite an interest has been created in Forestry, and this interest has been extended to the French Canadians of these counties, and they are beginning to plant ornamental shade trees, but from want of knowledge or care, with but little success. On our clay soil the only kind that appears to succeed are elms (soft), soft maple, the softer kinds of ash, cedar and poplars; hard maple struggles for existence for a time, but generally dies before many years old.

I am not aware of any lines of wind-breaks that have been planted, but along most of the side lines of the farmers on our rolling lands there are rows of elms, the natural product of seeds of the elm carried by the wind and deposited along the fences. Sheltered there these seeds germinated and were suffered to grow; but denuded of leaves in winter they can have but little effect upon the winds or in sheltering cattle; they have an injurious effect upon the crops within the circuit of their shade; bush may have a beneficial effect upon those more remote, those not shaded from the sun, but sheltered from the winds by the foliage of the trees.

Our fields generally have sufficient snow during its season. Belts of evergreens, parallel with lines of highways and forty or fifty feet distant therefrom, would greatly ameliorate the difficulties of winter travel, but lines of trees without foliage would afford little or no benefit.

PETER O'BRIEN.

FRONTENAC.

KINGSTON.—Your communication of the 15th just received. In reply—In this county at least one-half is still in only a partially settled state, the country being very rocky, much broken up with lakes, and, to a great extent, unfit for settlement. In such parts much of the primeval forest still remains, but diminishing each year on account of the fires originated often by carelessness, that rage every year. Not much has been done as yet in tree planting in this county. No wind-breaks, as far as I know, have been planted.

By the clearing off of the timber in the front townships, certainly, a change for the worse in the climate has been produced. There are fewer showers than in the localities where the forests still exist, though perhaps but little difference in the actual rainfall. The land being more exposed, dries up quicker, and, on the heavier soil, bakes up.

So far as stock is concerned, I don't suppose there is much difference, as in the front the farmers are generally going in for better things, and, of course, having more valuable animals, take better care of them.

Travelling is certainly rendered more difficult, but with us, I hope, even this will be soon reduced to a minimum by the general adoption of wire fences. In the higher and more exposed localities fall crops are certainly injured by the snow being blown from off them.

F. ELKINGTON.

NORFOLK.

COUNCIL CHAMBER, Simcoe, Jan. 29th, 1886.

DEAR SIR,—Your communication of December 15th, 1885, addressed to James Ermatinger, Clerk of the County of Norfolk, respecting Forestry, etc., was duly laid before the County Council who appointed us a committee to reply to your communication, and give you the desired information.

We have no doubt but that one of the prime causes of the floods which devastate our great valleys, as well as the extended droughts which from time to time dry up our springs, lessen the rain-fall, and deplete the granaries of many communities, is the destruction of the forests, and it logically follows that if such be the case, these lamentable results may be prevented, or greatly ameliorated by replanting trees in all suitable localities.

Concerning the change of climate, we are satisfied that as the country becomes denuded of its forests, the wind has greater sweep, and hence occur those destructive cyclones which spread such disaster and ruin in the West, and North-West, and in the older settled portions of this Province, the fields are more exposed to the wind-sweep in open winter, causing more or less destruction to fall-wheat and clover.

Throughout this county, especially in the older settled portions, the farmers generally have planted, or are beginning to plant trees for ornament and shade, the trees principally used being hard and soft maple, and placed along the roadsides and lanes.

In some few instances, the farmers have formed wind-breaks around orchards, farm-buildings, and fields, of light soil, which have proven beneficial; the trees used for this purpose being cedar, hemlock, spruce and willow.

The municipality of Woodhouse is the only one of the minor municipalities that has adopted the provisions of the Act for tree planting. The representatives from that municipality expressed the opinion that the list of trees for which a bonus might be paid, ought to be extended so as to include several varieties not now on the list.

We remain, your obedient servants,

WM. W. PEGG,	} Committee.
L. S. SOVEREIGN,	
J. D. CLEMENT,	

PROFITS OF PLANTING.

In the calculation following, we may learn a very valuable lesson by comparing it with the description of the walnut grove noticed in the earlier part of this book. It is stated in this calculation, no doubt based on growths the writer has observed, that at twenty-five years of age, walnut trees in Illinois, will average sixteen inches diameter at the base. It may be added to the description of the large grove visited in Illinois, that the trees were not, even in thirty years, up to this average. The cause of their backwardness, it will be found, is stated. Cattle had been allowed entrance to the grove, had rubbed the trees, and hardened the ground. It cannot be too often

remarked, that from all plantations, and from all forests, which it is desired shall thrive and reproduce themselves, cattle must be rigidly excluded.

Considering the quality of the grove I lately noticed in Illinois, notwithstanding the treatment it had received, it would appear that the following calculation, which, of course, refers to trees unexposed to such injuries, is not, by any means, an over estimate.

Statement of Mr. O. B. Galusha, of Illinois :—A few miles from my residence are a few acres of ground, which were cleared of timber sixteen or seventeen years since. There was then left upon the ground a growth of underbrush only, consisting of several varieties of oak, hickory, ash, and some other sorts. I have watched the growth of timber there from year to year, until the present time, and am myself surprised at the result. The land was worth, when cleared, perhaps \$12 per acre, not more. There have been taken from it, during the last seven years, poles equal in value, probably to \$10 per acre, and \$150 per acre would hardly buy the trees now standing upon it. So that if we estimate the value of the land (at the time mentioned) at \$12 per acre, and compute the interest upon this for sixteen years at six per cent. compound interest, adding the amount of taxes accruing during that time, with interest upon this at the same rates, we have \$100 per acre as the net profit of the timber crop ; while, of course, the land itself has partaken of the generally enhanced value of surrounding real estate, and would now probably sell for \$50 per acre, were the timber removed.

* * * Let us estimate the expense of raising a growth of ten acres, planted with white ash, and black walnut ; five acres of each. These varieties grow at about the same rate, and are about equally valuable for lumber.

The seeds of the ash, like all seeds of this class which ripen in autumn, should be gathered when ripe, and kept in the cellar through the winter. The walnuts, as other nuts, should be spread evenly upon the ground, where surface water will not stand, not more than two nuts in depth, and covered with two or three inches of yellow soil, that they may freeze during the winter ; to be planted as soon in spring as they show signs of sprouting. The land should be deeply ploughed, late in the fall if practicable, and finely pulverized in early spring, and marked both ways as for corn, three feet eight inches apart. The tree seeds and nuts should be planted eleven feet apart, which will admit of two rows of corn or potatoes between each two rows of trees. By putting two or three seeds in a place, to be thinned out to one, if both, or all germinate, an even stand can be secured.

A better way is to plant in rows eleven feet apart, running north and south, and three feet eight inches—(in the marks of the corn). This will secure straight trees, being closer, and they may be thinned out to eleven feet each way, when large enough to use for grape-stakes, bean or hop poles. This will give 300 trees per acre, or 3,000 trees in all, allowing for some vacancies, though, in all cases of tree planting, whether in groves or screens, a supply of good plants grown elsewhere should always be in readiness to use in filling vacancies, which should be done at the end of the first year.

The preparation of the ten acres at \$5 per acre would be \$50. Average cost of seed 50 cents per acre, \$5. Planting \$25. The cultivation during the first five years will be paid for in the crops grown between rows. For cultivation from fifth to ninth years, four years, with hoes only, \$30 per year, \$120. After this time no cultivation or care will be needed. This makes the entire cost in seed and labour, of the ten acres of trees \$200. These trees will, at twenty-five years of age, average sixteen inches in diameter at the ground, and about ten inches at the height of sixteen feet. This will give, deducting waste in sawing, 120 feet of lumber per tree. Allowing one-sixth for damage by the elements, and loss by other causes, we have in round numbers, 360,000 feet of lumber, which, at \$50 per M. would amount to \$18,000. The value of the tree-tops for fuel would be equal to the cost of preparing the logs for the mill, and the expense in sawing would not exceed \$5 per M. This, added to the cost of producing the trees, and the amount deducted from the value of the lumber, leaves \$16,000 for the use of ten acres of land for twenty-five years, and the interest upon the amount expended in planting and cultivating the trees !

This statement may be deemed incredible, perhaps, by those who have not previously turned their attention to the subject, but after much study, and many years' observation and measurements of growth of different varieties of trees, I am convinced that in all well-conducted experiments in growing artificial groves, upon our large prairies, the profits will not fail far, if at all, short of the rates above stated. It must be borne in mind, that trees standing at regular and proper distances upon rich prairie soil, and receiving good cultivation, will grow much faster than the same varieties found growing in natural groves. For a list of varieties suitable for planting in artificial groves, I would refer all interested to the lists recommended by our State Historical Society, with the remark that the planter can hardly be in error in planting any tree which is indigenous in a soil and climate similar to his own; while many trees whose native homes are found in latitudes north or south, have thus far proved valuable, as the osage, orange and catalpa from the South, and the red pine, and white spruce, and others from the North. Some foreign varieties are equal or superior to any of our natives, among which are the European, or Scotch larch (best of all foreign deciduous trees) Austrian and Scotch pines, Norway spruce, and white willow.

VALUE OF LARCH AS A CROP.

The larch is a tree which for the purpose of plantations it would be advisable to introduce extensively into this country. It is a beautiful tree, it is a tree of very rapid growth, it is fit for many outdoor purposes, and seems in certain situations almost indestructible by time. For one very important purpose, that is the making of railway ties, Mr. Douglas strongly recommends it. I have seen specimens in Illinois only ten or eleven years old with stems nearly a foot in diameter—a most extraordinary growth for so durable a wood. It should be remembered that it always succeeds best on high, dry, yet tolerably good land. Mr. Pinkerton, the celebrated detective, planted a large number of these trees near Chicago, but found that they were a comparative failure in the low, black soil. On high land, on the contrary, they succeeded well. In Ontario, near Sarnia, on good sandy loam, I have seen some very beautiful wind-breaks of larch, now over twenty feet in height. We have not as yet in America sufficient plantations of this tree to give an idea of the rate of profit obtainable by its growth. I have therefore given the best statistics I can find of European ones from a very reliable authority. From what I have seen, the tree grows more rapidly in Canada and the States than it is said to do in Europe. A careful perusal of the following statement by Mr. Michie will give an excellent idea of the profit to be expected.

There is certainly more truth in the adage, "The larch tree will buy a horse before the oak will buy its saddle," than in many others. There is no doubt that larch is the best paying wood crop that has yet been grown in this country. It can be cut and made use of at almost any age, and there is no tree better adapted for a great variety of purposes, especially for outside work.

No. 1 is a large plantation in the County of Sussex, planted originally with the view of producing a successive crop of hop-poles, being planted among Spanish chestnut and ash. In clearing the crop of hop-poles at twelve years' growth, the larch selected to stand were the strongest and best, and numbered about sixty trees per acre. At the end of thirty-two years the whole of the larches were cut down, as they were found to be destroying the under-wood, which was regarded as the most valuable part of the crop, and also because most of the trees had attained as high a state of perfection as the soil would admit of, it being a soft, white, sandy loam.

The following are the results of the crop when cut down; sixty trees, average about thirty cubic feet equal 1800 ft. at twenty cents per foot \$360 :—

The surrounding ground was letting at about \$5 per acre per annum.....	\$160 00
Plants (larch only) originally planted.....	2 50
Compound interest on first outlay at four per cent.....	6 00
	<hr/> \$168 50

It has to be noted that the sixty trees per acre selected to occupy the ground were not intended as a full crop, but only to supply what would otherwise have appeared a blank in the landscape; under-wood and hop-poles being the crop most preferred.

No. 2 is a plantation in Inverness-shire, comprehending 900 acres. It was planted in 1785, and was sold standing, and cut down in 1865, being eighty years old. The planting and early history are now little known, but it may be assumed that the turf dyke with which it was enclosed would cost about \$560, and the cost of plants, labour of planting, etc., about \$7.50 per acre; or, including cost of fence, about \$7,300. The thinning throughout its growth might be worth about \$50 per acre, and the crop in several parts realized fully \$500 per acre.

The crop when sold comprehended about 200 trees per acre, averaging from eight to eighty cubic feet each. The great difference of size of the trees may be accounted for from differences of soil, distance apart, some well clothed and others almost destitute of branches. No better proof can be adduced of the valuable state of the trees, than the circumstance, that a wood merchant offered \$1,500 for 100 of the trees, notwithstanding the distance was fully ten miles from the nearest station on the Highland Railway. The surrounding is letting as sheep pasture at about fifty cents per acre, while under larch it has realized \$6.25 minus compound interest on \$8, the original computed cost of forming the plantation.

No. 3. This is a plantation in Ross-shire, containing sixty acres, planted in 1812. It was originally enclosed with turf dyke, and planted with larch five feet apart. The whole expense of enclosing, plants, and planting were about \$9. Thinning was well attended to at an early age, and fencing being required in the district, induced thinning to be carried on to the great advantage of the future crop.

The soil is dry and sandy, with a sub-soil of stones and gravel. The natural herbage is a mixture of grass and heather. The average number of trees upon the ground is, or till recently was, 136 per acre, which averaged thirty cubic feet each, of saleable timber. The annual increase of wood at the present time is a little over one foot per tree, or say 25 cents, which multiplied by 136 gives \$34 as the annual increased value per acre. The whole crop is in a very healthy condition, and the growth is likely to continue satisfactory for about eighty years, at which age, assuming the growth to continue as at present, the value would stand thus—136 trees at present value, \$7.50 each \$1,020 per acre. Add to the above the interest of the next twenty-five years at \$34 per acre, and the value of eighty years will stand thus, equal \$1,870. Though within the bounds of possibility, and theoretically true, yet this will never be the saleable value, because in the nature of things, some trees will become diseased, some blown down by the wind, and others may be damaged in various ways from storms. Its present superior value, however, is due to two principal causes, namely, suitable soil and situation, and timely thinning.

No. 4. A plantation in Aberdeen-shire comprising about fifty acres, and thirty-eight years old. It was enclosed with a turf dyke and paling, and planted at distances apart of three and a-half to four feet. It is inland from the sea about twenty miles, and situated at an altitude of about 4,000 feet. The original cost of plants, planting and enclosing would be about \$11 per acre.

The combined objects of planting were; shelter to the surrounding fields in which it has proved a complete success, beautifying the estate, and finally yielding a good return for the money invested.

No thinning of any importance was ever done ; but nature assisted the work by way of the largest and strongest trees overgrowing and destroying the weaker ones. The result of the plantation being left to nature was, that out of 3,500 trees planted, one-third only now remain of living and growing trees ; and were the plantation to stand till sixty years old, 500 healthy growing trees would be the maximum number per acre.

This plantation is probably now at its highest attainable value ; when about 1,000 trees per acre occupy the ground, and are worth about forty cents each, making the value per acre \$415. Allowing \$65 per acre for original-outlay and interest, \$350 remains to be divided over thirty-eight years—the medium age—equal to \$9.25, nearly the annual return per acre.

The ground surrounding this plantation is letting at about \$1.25 per acre, thus showing, that certain soils planted with larch are very profitable investments, and ought to be taken advantage of when they occur. This plantation is also depastured, and for that purpose is worth at least \$1 per acre ; at the same time the progressive value of the crop of wood is over \$10 annually per acre, and calculated to increase.

No. 5 is a series of plantations upon an estate in the south of Inverness-shire, comprising in all about 200 acres, which may be described as one plantation. The whole was planted between the years 1817 and 1827, the oldest part being now sixty-three, and the youngest part fifty-three years old. The trees were planted four and a half and five feet apart. Turf dykes enclosed nearly the whole plantation, but, as already stated, being executed in detachments, nothing reliable can be given as to the actual cost. As the joint object in forming this plantation was shelter and profit, so long as it fulfilled the former and was too young to yield the latter, no attention was paid to it in the way of thinning till nearly thirty years planted, when parts were thinned for pit props ; and in thinning for this purpose, instead of cutting down all the inferior growths and sickly trees, the reverse of this was practised ; and in general those trees were cut which were most suitable for the market, without respect to the permanent crop. The result was that many of the slender up-drawn trees were blown down.

This manner of thinning was not continued throughout the whole extent of the plantation, hence portions of it escaped this improper treatment. At the present time this plantation is in general, in a thriving state. Having a dry soil and sub-soil favours it greatly. Where the trees are not in a vigorous state of growth, it is owing to the soil being too hard and impervious for the roots to run in ; but where the soil is at all loose and open, the trees are growing well. The following are three respective valuations of the crop :—First valuation, 3,000 trees, at \$1.40 each—\$312 ; second, 240 trees, at \$1 each—\$240 ; third, 220 trees, at 87c. each—\$191. In the first estimate those acres containing the largest number of trees are of most value because the good trees were not cut down ; and in the latter case, where the number of trees is small, the value is also small, because in thinning the best trees were cut, and the number per acre so reduced as not to leave the ground properly covered.

No. 6 is a larch plantation in Roxburgh-shire, intermixed with Scotch fir. It was planted from 1820 to 1822, both inclusive. The plantation is situated upon the ridge of a hill extending from south to north, at an altitude between 400 and 500 feet. The soil is of various qualities, but the greater portion is of a clayey nature, resting upon yellow clay ; whinstone rocks abounding in the district. The plantation extends to about thirty-five acres ; its form is oblong—about 1,300 yards long by 120 broad. It is enclosed with a turf dyke, at the time of its erection the most common fence in that part of the country.

As far as can be ascertained, the following is the cost per acre, including all expenses :

Eighty-nine yards turf dyke, at 4c. per yard	\$ 3 56
3,000 plants, at \$3 per 1,000	9 00
Planting the above, at \$1 per 1,000	3 00
360 yards open drain, at 2c. per yard	7 20
Incidental expenses, including carriage of plants.....	1 00

\$23 76

At forty years growth parts of the crop were valued, and the valuations stood thus:—No. 1, 200 trees, at 35c. each—\$70; No. 2, 220 trees, at 40c.—\$88; No. 3, 1,900 trees, at 50c. each—\$950; No. 4, 240 trees, at 60c. each—\$144. From the above it will appear what progress the trees had made. The wood in each tree is calculated at 25c. per cubic foot, so that the largest average did not exceed five feet, which is a small increase compared with the growth of many larch plantations. The deficiency of growth may be accounted for from the stiff clay soil, cold sub-soil and neglect of timeous thinning.

No. 7 is a tract of larch in Ashdown Forest, between East Greenstead and Rotherfield, in the County of Sussex. One part, comprising about 300 acres, is worthy of special description.

The larches here, and generally all over this part of the country, are planted from two to two and a half feet apart, and allowed to remain at that distance till about twelve to fourteen years old; at the latter age about three-fourths of the crop are cut down for hop-poles, leaving the remaining one-fourth to grow up as a crop of timber. The result of this severe thinning is injurious to the remaining crop, even in England, and would be probably fatal in Scotland, with a colder climate.

The difference of growth is not due to the shape of the tree, but to the branches situated near the base of the trunk, which supply the roots with nourishment.

Several circumstances tend to the success and rapid growth of these plantations; the distance from the sea (twenty miles); altitude 400 to 500 feet; soil dry, open hazel loam, resting upon iron ore; free, open exposure; and no mixture of evergreen trees. The variable state of the soil manifested itself here in the following ways:—In one place a poor white sand prevailed, upon which the trees were all “pumped” and their growth nearly over. In a few places clay prevailed, and hereupon the dead stocks showed that the trees had died at about fifteen years growth. “Moor-pan” was found in some parts, and where the trees came in contact with it, the growth had ceased early, and those still living showed a general rigidity and stuntedness of growth.

The only apparent difference between larch grown in the South of England and the North of Scotland, consists in the rapidity of their growth in the former country, and attaining maturity at an earlier age. Eighty years may be the maximum age for a larch plantation in the County of Argyle or Ross-shire, and fifty the maximum age for plantations in Sussex, Surrey, or Kent.—*Michie*.

VALUE OF WOOD AS A CROP UPON LAND.

The following article by a well-known writer, and a person of great experience in these subjects, James Brown, Esq., LL.D., Port Elgin, gives an excellent idea of what returns may be expected from timbered land. The examples are British, as we cannot as yet, find examples of planted land here in sufficient extent and forwardness. But when we consider the prices obtained on this side of the Atlantic for timber, it will be found that, the carriage being saved by growing it near where it is likely to be wanted, and what is a very important matter, growing it where customers are close by, and can see the kinds of timber they need without travelling great distances, a very good profit is likely to be realized here. For, as elsewhere remarked, a close-growing plantation is a very different matter from a natural forest. Where sticks of timber are grown in line, like vegetables in rows, with the intent to produce tall, thick, clear stems, the difference is something like that between gathering strawberries from a planted garden plot, and looking in the old-fashioned way for them in the fields where they grew here and there a nature permitted them. The day is rapidly approaching when he who plants trees now well, and attends to them carefully, will find he has realized much more from the ground

than cropping or pasturing would have given him. The shelter, also, as well remarked in the concluding sentences, will greatly aid his other land. The extract will well repay careful perusal :—

The value of wood as a crop upon any given piece of ground depends very much on the treatment it may have received in its cultivation. Trees, like every other useful product of the soil, may be considered deteriorated in value by unskilful and careless management, and they may be also greatly enhanced in value by skilful and careful management. Besides, the value of wood varies according to the nature of the land planted, and also according as the locality may or may not be conveniently situated as regards a ready market for the sale of timber.

However, we may here state as a general rule, which we have verified from our own experience, both in England and Scotland, that land which is from various causes unfit for high farming, will, under wood, at the end of seventy years, under good management, pay the proprietor nearly three times the sum of money that he would have received from any other crop upon the same piece of ground.

This assertion, we are aware, will be considered extravagant by many proprietors, but to those who may consider what we have here said as beyond the truth, we beg to say that, although it may be in reality beyond what they have themselves experienced as to profits arising from their plantations, yet in all cases where good management has been introduced, what we have said will be found a practical truth ; and, in order to illustrate the point, we shall here give a few examples without going into detail, most of which have come under our own experience in dealing with woods in different parts of the country.

On three estates that we have had to deal with in the north of Scotland, where the woods are chiefly larch and Scots pine, and where regular accounts of the sales of the produce had been kept for a period of nearly forty years previous to our visiting them, we found that, taking the older class of the pine woods, they had yielded on the average, about 13s. per acre per annum for thinnings during the forty years accounts had been kept of sales from them ; and that, where clearings had been made of these, the matured crops had realized, on an average, about £70 per acre, after the removal of all the thinnings that had from time to time been taken from them.

The larch portions of the crops on these estates realized about one-half more than the pine portions—that is, the annual average value realized from the thinnings of the larch was, for the forty years referred to, 20s. per acre ; and where clearings had been made of this kind, the matured crop had yielded £106 per acre on an average.

The annual rent of the land, at an average, upon which those plantations grew, was reckoned at 4s. 6d. an acre, and the crops, when matured, had occupied the land for a period of about seventy years. Now, had it been occupied by tenants for the purpose of grazing, the proprietors would have received only £15 15s. for an acre during the period of seventy years, but being occupied by trees, we see that they received, by the end of the period of seventy years, when the crops were cleared, no less than 27s. 6d. for each year of the period in respect to each acre of that occupied by the pine crops, and about 41s. 6d. for each year in respect to each acre occupied by the larch. Now, even after deducting every necessary expense the proprietors were put to, and after deducting compound interest upon the original outlay and rent, progressively, during the time when no return was received, it will be found, as we have formerly stated, that such land when planted with trees, will pay fully three times the amount of money that it would do in the hands of farmers ; and this points out that wood as a crop, even when managed in an ordinary way, is exceedingly profitable to the proprietor, and adds greatly to the value of his estate.

Next, in the south of Scotland and north of England, we have seen the matured crops of larch sold at prices ranging from £150 up to £380 the acre, and this irrespective of the value of thinnings that had been removed from them during their young and growing stages. The land on which these crops grew was valued at rates varying from 10s. to 15s. per acre per annum, and the crops when cleared were of from sixty-five to seventy years' standing.

We may here mention that in the north of England a crop of matured larch was sold some time ago at the rate of £500 per acre. We have this information from a well-informed forester, who lives in the neighbourhood of the estate where this high sum was realized, and whose information is to be relied on. He says this crop grew on a sloping bank unfit for the plough.

In the south of Scotland and north of England we have seen crops of matured Scots pine sold at rates, per acre, varying from £65 up to £200. The age of these might be about seventy-five years on an average, and the rent of the land about 15s. per acre.

In the same parts of the country we have seen matured crops of mixed hardwood plantations sold at rates varying from £80 to £170 per acre, and in one or two cases as high as £220.

Again, on the same parts we have seen matured crops of oak sold at prices, per acre, varying from £200 to £400.

In the cases referred to under the five preceding paragraphs, it must be kept in view that no account is taken of the thinnings which had been removed from the several crops while they were in the growing state, and before they became matured, as any information as regards that source of income could not be obtained.

What we have said above refers to the value of a crop of wood when trained up to timber trees. There are, however, many proprietors who cultivate a large portion of their woodlands upon the principle of coppice-woods, which are growths from the stocks of trees formerly cut over; and as to the value of this class of crop, it will suffice to say that it does not, so far as our experience goes in dealing with it, pay nearly so well as a crop of timber. We have had to do with this class of crop on places in the west and south of Scotland, and in the central and northern counties of England, and have seldom found it pay the proprietor over 15s. per acre per annum for the land it occupied.

These examples we consider quite sufficient for the present purpose. We might, indeed, give many others in illustration of the point under notice, but as they would only go to swell this work without altering the facts stated, we think it preferable not to do so. But we may add that it is not alone the simple value of the timber that makes plantations of so important a nature upon a gentleman's property: there is the shelter they afford for all agricultural purposes, and their beneficial effects for regulating the climate; for where no plantations exist there is invariably an inferior crop of grain upon the fields, besides an ill-fed live-stock, which should all be taken into account. We are, indeed, of opinion that upon any landed property, well-managed plantations are incalculably of more value than lands three times their extent in the hands of a farmer, but without trees to give shelter; and it is well known by every proprietor of land that he receives by far the highest rent for those parts of his lands which are most sheltered by his best plantations. And further, of whatever value land may be in the hands of a farmer without plantations to give shelter to it, it is of very much greater value when properly sheltered by them.

INJURIES CAUSED BY LOSS OF FORESTS.

Concerning the injury caused by overclearing in other lands, the statements of historians and geographers give many and conclusive instances too diffuse and general for quotation here. They have been summarized and general deductions drawn with such accuracy, and at the same time with such eloquence, by Mr. Marsh, that I cannot do better than reproduce his statement here. Any one who will take the trouble to read carefully the next few pages will learn more of the subject—of the philosophic and historic reasons on which the principles of forest preservation are based—than can be found in the same space in any other work in the world, and will at the same time enjo

the advantages of perusing a portion of the works of one of the most powerful of American word painters. Mr. Marsh views the question with the eye of a philosopher, and a citizen of the world, sifts the evidence and gives the results in a spirit of most sagacious reason. Any one who desires to inform themselves concerning forestry in its most broad and comprehensive view, would do well to read and re-read what Mr. Marsh has here said concerning it.

PHYSICAL DECAY OF THE TERRITORY OF THE ROMAN EMPIRE, AND OF OTHER PARTS OF THE OLD WORLD.

If we compare the present physical condition of these countries, with the descriptions that ancient historians and geographers have given of their fertility and general capability of ministering to human uses, we shall find that more than one-half their whole extent—including the provinces most celebrated for the profusion and variety of their spontaneous and their cultivated products, and for the wealth and social advancement of their inhabitants—is either deserted by civilized man and surrendered to hopeless desolation, or at least greatly reduced in both productiveness and population. Vast forests have disappeared from mountain spurs and ridges; the vegetable earth accumulated beneath the trees by the decay of leaves and fallen trunks, the soil of the alpine pastures which skirted and indented the woods, and the mould of the upland fields, are washed away; meadows, once fertilized by irrigation, are waste and unproductive, because the cisterns and reservoirs that supplied the ancient canals are broken, or the springs that fed them are dried up; rivers famous in history and song have shrunk to little brooklets; the willows that ornamented and protected the banks of the lesser watercourses are gone, and the rivulets have ceased to exist as perennial currents, because the little water that finds its way into their old channels is evaporated by the droughts of summer, or absorbed by the parched earth before it reaches the lowlands; the beds of the brook have widened into broad expanses of pebble and gravel, over which, though in the summer season passed dry-shod, in winter sealike torrents thunder; the entrances of navigable streams are obstructed by sandbars; and harbours, once marts of an extensive commerce, are shoaled by the deposits of the rivers at whose mouths they lie: the elevation of the beds of estuaries, and the consequently diminished velocity of the streams which flow into them, have converted thousands of leagues of shallow sea and fertile lowland into unproductive and miasmatic morasses.

Besides the direct testimony of history to the ancient fertility of the regions to which I refer—Northern Africa, the greater Arabian peninsula, Mesopotamia, Armenia, and many other provinces of Asia Minor, Greece, Sicily, and parts of even Italy and Spain—the multitude and extent of yet remaining architectural ruins, and of decayed works of internal improvements, show that at former epochs a dense population inhabited these now lonely districts. Such a population could only have been sustained by a productiveness of soil of which we at present discover but slender traces; and the abundance derived from that fertility serves to explain how large armies like those of the ancient Persians, and of the Crusaders, and the Tartars in later ages, could, without an organized commissariat, secure adequate supplies in long marches through territories, which, in our time, would scarcely afford forage for a single regiment.

The ravages committed by man subvert the relations and destroy the balance which nature has established between her organized, and her inorganic creations; and she avenges herself upon the intruder, by letting loose upon her defaced provinces destructive energies hitherto kept in check by organic forces destined to be his best auxiliaries, but which he has unwisely dispersed and driven from the field of action. When the forest is gone, the great reservoir of moisture stored up in its vegetable mould is evaporated, and returns only in deluges of rain to wash away the parched dust into which that mould has been converted. The well-wooded and humid hills are turned to ridges of dry rock, which encumbers the low ground and chokes the watercourses with its debris, and—except in few countries favoured with an equable distribution of rain through the seasons, and a moderate and regular inclination of surface—the whole earth, unless

rescued by human art from the physical degradation to which it tends, becomes an assemblage of bald mountains, of barren, turfless hills, and of swampy and malarious plains. There are parts of Asia Minor, of Northern Africa, of Greece, and even of Alpine Europe, where the operation of causes set in action by man has brought the face of the earth to a desolation almost as complete as that of the moon; and though within that brief space of time which we call "the historical period," they are known to have been covered with luxuriant woods, verdant pastures, and fertile meadows, they are now too far deteriorated to be reclaimable by man, nor can they become again fitted for human use, except through great geological changes, or other mysterious influences or agencies of which we have no present knowledge, and over which we have no prospective control. The earth is fast becoming an unfit home for its noblest inhabitant, and another era of equal human crime and human improvidence, and of like duration with that through which traces of that crime and improvidence extend, would reduce it to such a condition of impoverished productiveness, of shattered surface, of climatic excess, as to threaten the deprivation, barbarism, and perhaps even extinction of the species.

INFLUENCE OF THE FOREST ON INUNDATIONS.

In the Northern United States, although inundations are sometimes produced in the height of summer by heavy rains, it will be found generally true that the most rapid rise of the waters, and, of course, the most destructive "freshets," as they are called in America, are produced by the sudden dissolution of the snow before the open ground is thawed in the spring. It frequently happens that a powerful thaw sets in after a long period of frost, and the snow which had been months in accumulating is dissolved and carried off in a few hours. When the snow is deep, it, to use a popular expression, "takes the frost out of the ground" in the woods, and if it lies long enough, in the fields also. But the heaviest snows usually fall after midwinter, and are succeeded by warm rains or sunshine, which dissolve the snow on the cleared land before it has had time to act upon the frost-bound soil beneath it. In this case, the snow in the woods is absorbed as fast as it melts, by the soil it has protected from freezing, and does not materially contribute to swell the current of the rivers. If the mild weather, in which great snowstorms usually occur, it is almost sure to be followed by drifting winds, and the inequality with which they distribute the snow, leaves the ridges comparatively bare, while the depressions are often filled with drifts to the height of many feet. The knolls become frozen to a great depth; succeeding partial thaws melt the surface snow, and the water runs down into the furrows of ploughed fields, and other artificial and natural hollows, and then often freezes to solid ice. In this state of things almost the entire surface of the cleared land is impervious to water, and from the absence of the trees and the general smoothness of the ground, it offers little mechanical resistance to superficial currents. If, under these circumstances, warm weather accompanied by rain occurs, the rain and melted snow are swiftly hurried to the bottom of the valleys and gathered to raging torrents.

It ought further to be considered that, though the lighter ploughed soils readily imbibe a great deal of water, yet the grass lands, and all the heavy and tenacious earth, absorb it in much smaller quantities, and less rapidly than the vegetable mould of the forest. Pasture, meadow, and clayey soils, taken together, greatly predominate over the sandy ploughed fields in all large agricultural districts, and hence, even if in the case we are supposing, the open ground chances to have been thawed before the melting of the snow which covers it, it is already saturated with moisture or very soon becomes so, and of course cannot relieve the pressure by absorbing more water. The consequence is that the face of the country is suddenly flooded with a quantity of melted snow and rain equivalent to a fall of six or eight inches of the latter, or even more. This runs unobstructed to rivers often still bound with thick ice, and thus inundations of a fearfully devastating character are produced. The ice bursts from the hydrostatic pressure from below, or is violently torn up by the current, and is swept by the impetuous stream, in large masses and with resistless fury, against banks, bridges, dams and mills erected near them. The bark of the trees along the rivers is often abraded, at a height of many feet above the ordinary water level, by cakes of floating ice, which are at last stranded by the

receding flood on meadow or plough land, to delay, by their chilling influence, the advent of the tardy spring.

The surface of a forest in its natural condition, can never pour forth such deluges of water as flow from cultivated soil. Humus, or vegetable mould, is capable of absorbing almost twice its own weight in water. The soil in a forest of deciduous foliage is composed of humus, more or less unmixed, to the depth of several inches, sometimes even of feet; and this stratum is usually able to imbibe all the water possibly resulting from the snow at any one time covering it. But the vegetable mould does not cease to absorb water when it becomes saturated, for it then gives off a portion of its moisture to the mineral earth below, and thus is ready to receive a new supply, and, besides, the bed of leaves not yet converted to mould, takes up and retains a very considerable proportion of snow water, as well as of rain.

If the summer floods in the United States are attended with less pecuniary damage than those of the Loire and other rivers of France, the Po and its tributaries in Italy, the Emme and her sister torrents which devastate the valleys of Switzerland, it is partly because the banks of the American rivers are not yet lined with towns, their shores, and the bottoms which skirt them not yet covered with improvements whose cost is counted by millions, and consequently, a smaller amount of property is exposed to injury by inundation. But the comparative exemption of the American people from the terrible calamities which the overflow of rivers has brought on some of the fairest portions of the Old World, is, in a still greater degree, to be ascribed to the fact that, with all our thoughtless improvidence, we have not yet bared all the sources of our streams, not yet overthrown all the barriers which nature has erected to restrain her own destructive energies.

Let us be wise in time, and profit by the errors of our older brethren.

DUTY OF PRESERVING THE FOREST.

In fertile countries, like the United States, the foreign demand for animal and vegetable aliment, for cotton, and for tobacco, much enlarges the sphere of agricultural operations, and, of course, prompts further encroachments upon the forest. The commerce in these articles, therefore constitutes in America a special cause in the destruction of the woods, which does not exist in the numerous States of the Old World, that derive the raw material of their mechanical industry from distant lands, and import many articles of vegetable food or luxury which their own climate cannot advantageously produce.

The growth of arboreal vegetation is so slow that, though he who buries an acorn may hope to see it spring up to a miniature resemblance of the majestic tree which shall shade his remote descendants, yet the longest life hardly embraces the seedtime and the harvest of a forest. The planter of a wood must be actuated by higher motives than those of an investment, the profits of which consist in direct pecuniary gain to himself, or even to his posterity; for, if in rare cases, an artificial forest may, in two or three generations, more than repay its original cost, still, in general, the value of its timber will not return the capital expended and the interest accrued. But when we consider the immense collateral advantages derived from the presence, the terrible evils necessarily resulting from the destruction of the forest, both the preservation of the existing woods, and the far more costly extension of them where they have been unduly reduced, are among the most obvious of the duties which this age owes to those that are to come after it. Especially is this obligation incumbent upon Americans. No civilized people profits so largely from the toils and sacrifices of its immediate predecessors than they; no generation have ever sown so liberally, and, in their own persons, reaped so scanty a return, as the pioneers of Anglo-American social life. We can repay our debt to our noble fathers only by a like magnanimity, by a like self-forgetting care for the moral and material interests of our own posterity.

GENERAL FUNCTIONS OF FORESTS.

It is found that the electrical and chemical action of the forest, though obscure, exercises probably a beneficial, certainly not an injurious influence on the composition

and condition of the atmosphere ; that it serves as a protection against the diffusion of miasmatic exhalations, and malarious poisons ; that it performs a most important function as a mechanical shelter from blasting winds to grounds in the lee of it ; that, as a conductor of heat, it tends to equalize the temperature of the earth, and air ; that its dead products form a mantle over the surface, which protects the earth from excessive heat and cold ; that the evaporation from the leaves of living trees, while it cools the air around them, diffuses through the atmosphere a medium which resists the escape of warmth from the earth by radiation, and hence that its general effect is to equilibrate caloric influences, and moderate extremes of temperature.

It is found, further, that the forest is equally useful as a regulator of terrestrial and of atmospheric humidity, preventing, by its shade, the drying up of the surface by parching winds, and the scorching rays of the sun, intercepting a part of the precipitation, and pouring out a vast quantity of aqueous vapour into the atmosphere ; that, if it does not increase the amount of rain, it tends to equalize its distribution, both in time, and in place ; that it preserves a hygrometric equilibrium in the superior strata of the earth's surface ; that it maintains and regulates the flow of springs and rivulets ; that it checks the superficial discharge of the waters of precipitation, and consequently tends to prevent the sudden rise of rivers, the violence of floods, the formation of destructive torrents, and the abrasion of the surface by the action of running water ; that it impedes the fall of avalanches, and of rocks, and destructive slides of the superficial strata of mountains ; that it is a safeguard against the breeding of locusts, and finally, that it furnishes nutriment and shelter to many tribes of animal and vegetable life which, if not necessary to man's existence, are conducive to his rational enjoyment.

In fine, in well wooded regions, and in inhabited countries, where a due proportion of soil is devoted to the growth of judiciously distributed forests, natural destructive tendencies of all sorts are arrested or compensated, and man, bird, beast, fish and vegetable alike find a constant uniformity of condition most favourable to the regular and harmonious co-existence of them all.

GENERAL CONSEQUENCES OF THE DESTRUCTION OF THE FOREST.

With the extirpation of the forest, all is changed. At one season, the earth parts with its warmth by radiation to an open sky—receives, at another, an immoderate heat from the unobstructed rays of the sun. Hence, the climate becomes excessive, and the soil is alternately parched by the fervors of summer, and seared by the rigors of winter. Bleak winds sweep unresisted over its surface, drift away the snow that sheltered it from the frost, and dry up its scanty moisture. The precipitation becomes as irregular as the temperature ; the melting snows, and vernal rains, no longer absorbed by a loose and bibulous vegetable mould, rush over the frozen surface, and pour down the valleys seawards, instead of filling a retentive bed of absorbent earth, and storing up a supply of moisture to feed perennial springs. The soil is bared of its covering of leaves, broken and loosened by the plough, deprived of the fibrous rootlets which held it together, dried and pulverised by sun and wind, and, at last exhausted by new combinations.

The face of the earth is no longer a sponge, but a dust-heap, and the floods which the water of the sky pour over it hurry swiftly along its slopes, carrying in suspension vast quantities of earthy particles which increase the abrading power and mechanical force of the current, and, augmented by the sand and gravel of falling banks, fill the beds of the streams, divert them into new channels, and obstruct their outlets. The rivulets, wanting their former regularity of supply, and deprived of the protecting shade of the woods, are heated, evaporated, and thus reduced in their summer currents, but swollen to raging torrents in autumn and in spring. From these causes there is a constant degradation of the uplands, and a consequent elevation of the beds of water-courses and of lakes by the deposition of the mineral and vegetable matter carried down by the waters. The channels of great rivers become unnavigable, their estuaries are choked up, and harbours which once sheltered large navies are shoaled by dangerous sand-bars.

The earth, stripped of its vegetable glebe, grows less and less productive, and consequently, less able to protect itself by weaving a new network of roots to bind its par-

ticles together, a new carpeting of turf to shield it from wind and sun, and scouring rain. Gradually it becomes altogether barren. The washing of the soil from the mountains leaves bare ridges of sterile rock, and the rich, organic mould which covered them, now swept down into the dank, low grounds, promotes a luxuriance of aquatic vegetation that breeds fever, and more insidious forms of mortal disease by its decay, and thus the earth is rendered no longer fit for the habitation of man.

To the general truth of this sad picture there are many exceptions, even in countries of excessive climates. Some of these are due to favourable conditions of surface, of geological structure, and the distribution of rain; in many others, the evil consequences of man's improvidence have not yet been experienced, only because a sufficient time has not elapsed since the felling of the forest to allow them to develop themselves. But the vengeance of Nature for the violation of her harmonies, though slow, is sure; and the gradual deterioration of soil and climate in such exceptional regions is as certain to result from the destruction of the woods as is any natural effect to follow its cause.

TREES AS SHELTER TO GROUND TO THE LEeward.

As a mechanical obstruction, trees impede the passage of air-currents over the ground^y which as is well known, is one of the most efficient agents in promoting evaporation, and the refrigeration resulting from it. In the forest, the air is almost quiescent, and moves only as local changes of temperature affect the specific gravity of its particles. Hence, there is often a dead calm in the woods, when a furious blast is raging in the open country at a few yards distance.

The denser the forest—as, for example, where it consists of spike-leaved trees, or is thickly intermixed with them—the more obvious is its effect, and no one can have passed from the field to the wood in cold, windy weather without having remarked it.

The action of the forest, considered merely as a mechanical shelter to grounds lying to the leeward of it, might seem to be an influence of too restricted a character to deserve much notice; but many facts concur to show that it is a most important element in local climate.

It is evident that the effect of the forest, as a mechanical impediment to the passage of wind, would extend to a very considerable distance above its own height, and hence, protect while standing, or lay open when felled, a much larger surface than might at first thought be supposed. The atmosphere, movable as are its particles, and light and elastic as are its masses, is nevertheless held together as a continuous whole by the gravitation of its atoms, and the consequent pressure on each other, if not by attraction between them, and, therefore, an obstruction which mechanically impedes the movement of a given stratum of air, will retard the passage of the strata above and below it.

To this effect may be often added that of an ascending current from the forest itself, which must always exist when the atmosphere within the wood is warmer than the stratum of air above it, and must be of almost constant occurrence in the case of cold winds, from whatever quarter, because of the still air in the forest is slow in taking up the temperatures of the moving columns and currents above and around it. Experience, in fact, has shown that mere rows of trees, and even much lower obstruction, are of essential service in defending vegetation against the action of the wind.

Hardy proposes planting, in Algeria, belts of trees at the distance of 100 meters from each other, as a shelter, which experience had proved to be useful in France. "In the valley of the Rhine," says Becquerel, "a simple hedge, two meters in height, is a sufficient protection for a distance of twenty-two meters."

The mechanical shelter acts, no doubt, chiefly as a defence against the mechanical force of the wind, but its uses are by no means limited to this effect. If the current of air which it resists moves horizontally, it would prevent the access of cold, or parching blasts to the ground for a great distance; and did the wind even descend at a large angle with the surface, still a considerable extent of ground would be protected by a forest to the windward of it.

It is thought in Italy that the clearing of the Apennines has very materially affected the climate of the valley of the Po. It is asserted in *Le Alpi che cingono l'Italia* that:

"In consequence of the felling of the woods on the Apennines, the sirocco prevails greatly on the right bank of the Po, in the Parmesan Territory, and in a part of Lombardy; it injures the harvests and the vineyards, and sometimes ruins the crops of the season. To the same cause many ascribe the meteorological changes in the precincts of Modena and Reggio. In the communes of these districts, where formerly straw roofs resisted the force of the winds, tiles are now hardly sufficient; in others, where tiles answered for roofs, large slabs of stone are ineffectual; and in many neighbouring communes, the grapes and the grain are swept off by the blasts of the south, and south-west winds."

According to the same authority, the pinery of Porto, near Ravenna,—which is twenty miles long, and is one of the oldest pine woods in Italy—having been replanted with resinous trees, after it was unfortunately cut, has relieved the city from the sirocco, to which it had become exposed, and, in a great degree, restored its ancient climate.

The felling of the woods on the Atlantic coast of Jutland, has exposed the soil, not only to drifting sands, but to sharp sea-winds, that have exerted a sensible deteriorating effect on the climate of that peninsula, which has no mountains to serve at once as a barriers to the force of the winds, and as a store-house of moisture received by precipitation, or condensed from atmospheric vapours.

The local retardation of spring, so much complained of in Italy, France, and Switzerland, and the increased frequency of late frosts at that season, appear to be ascribable to the admission of cold blasts to the surface, by the felling of the forests, which formerly both screened it as by a wall, and communicated the warmth of their soil to the air and earth to the leeward.

Caimi states that since the cutting down of the woods of the Apennines, the cold winds destroy, or stunt the vegetation, and that, in consequence of the usurpation of winter on the domain of spring, the district of Mugello has lost all its mulberries, except the few which find in the lee of buildings a protection like that once furnished by the forest.

The department of Ardèche, which now contains not a single considerable wood, has experienced within thirty years a climatic disturbance, of which the late frosts, formerly unknown in the country, are one of the most melancholy effects. Similar results have been observed in the plane of Alsace, in consequence of the denudation of several of the crests of the Vosges.

Dussard, as quoted by Ribbe, maintains that even the *mistral*, or north-west wind, whose chilling blasts are so fatal to tender vegetation in the spring, "is the child of man, the result of his devastations." "Under the reign of Augustus," continues he, "the forests which protected the Cevennes were felled, or destroyed by fire, in mass. A vast country, before covered with impenetrable woods—powerful obstacles to the movement, or even to the formation of hurricanes—was suddenly denuded, swept bare, stripped, and soon after a scourge hitherto unknown, struck terror over the land, from Avignon to the Bouches-du-Rhone, thence to Marseilles, and then extended its ravages, diminished, indeed by a long career, which had partially exhausted its force, over the whole maritime frontier. The people thought this wind a curse sent of God. They raised altars to it, and offered sacrifices to appease its rage."

It seems, however, that this plague was less destructive than at present, until the close of the sixteenth century, when further clearings had removed most of the remaining barriers to its course. Up to that time, the north-west wind appears not to have attained to the maximum of specific effect which now characterizes it as a local phenomenon. Extensive districts, from which the rigor of the seasons has now banished valuable crops, were not then exposed to the loss of their harvests by tempests, cold or draught. The deterioration was rapid in its progress. Under the consulate, the clearings had exerted so injurious an effect upon the climate, that the cultivation of the olive had retreated several leagues, and since the winters and springs of 1820, and 1836, this branch of rural industry has been abandoned in a great number of localities where it was advantageously pursued before. The orange now flourishes only at a few sheltered points of the coast, and it is threatened even at Hyères, where the clearing of the hills near the town has proved very prejudicial to this valuable tree.

Marchand informs us that, since the felling of the woods, late spring frosts are more frequent in many localities north of the Alps; that fruit trees thrive no longer, and that it is difficult even to raise young fruit-trees.

THE FORESTS OF THE UNITED STATES.

The reader will find here a complete statement of the condition of Forestry in the different States of the Union, giving the amount of forest standing in each State, the kinds of wood growing, the manner in which it has been or is being cleared, and, wherever answers have been received, letters from the Commissioners of Agriculture in the various States, giving additional details and statements of the methods of forest preservation, if any, practised within the limits of their several states. It is most important, in the interests of Canadian Forestry, that these should be well understood here: first, for the reason that the value of, and necessity of preserving forests on one part of the continent most necessarily depend on the quantity in others, so far as mere merchantable value is concerned; next, that it is most advantageous, in our examination of the steps advisable in our Forestry affairs, to make use of the example these neighbouring countries have set, to observe where and what injuries they have suffered by over-clearing, and the means they are taking to repair the damage, or guard against its recurrence. We have to avail ourselves, in this matter, of the researches made and experiments noticed by other nations. and the valuable and extensive Forestry Report of Mr. Sargent, lately compiled at great expense for the American Government, has afforded a means of obtaining forestry information which has been largely used in the following summary. The whole may be briefly stated. There are yet vast forests in the Southern States comparatively untouched. Those of the North are being rapidly used, at such a rate as foretells the not distant disappearance of all the best timber, the consequent transference to the South of the principal wood-working industries, and a complete change in the location and chief depots of the lumber traffic.

The Forests of the United States, in spite of the great and increasing drains made upon them, are capable of yielding annually, for many years longer, a larger amount of material than has yet been drawn from them, even with our present reckless methods of forest management. The great pine forest of the North has already, it is true, suffered fatal inroads. The pine which once covered New England and New York has almost disappeared. Pennsylvania is nearly stripped of her pine, which once appeared inexhaustible. The great north-western pineries are not yet exhausted, and with newly introduced methods, by which trees supposed inaccessible are now profitably brought to the mills, they may be expected to increase the volume of their annual product for a few years longer, in response to the growing demands of the great agricultural population fast covering the treeless mid-continental plateau. The area of pine forest, however, remaining in the pine-producing States of Michigan, Wisconsin, and Minnesota, is dangerously small in proportion to the country consumption of white pine lumber, and the entire exhaustion of these forests in a comparatively short time is certain. The wide areas now covered in New England by a vigorous second growth of white pine, although insignificant in extent and productiveness in comparison with the forest it replaces, must not be overlooked in considering the pine supply of the country. These new forests, yielding already between two and three hundred million feet of lumber annually, are capable of great future development.

The pine belt of the South Atlantic region still contains immense quantities of timber unequalled for all purposes of construction, although unsuited to take the place of

the white pine of the north. The southern pine forests, although stripped from the banks of the stream flowing into the Atlantic, are practically untouched in the Gulf States, especially in those bordering the Mississippi River. These forests contain sufficient material to long supply all possible demands which can be made upon them.

The hardwood forests of the Mississippi Basin are still, in certain regions at least, important, although the best walnut, ash, cherry, and yellow poplar have been largely culled. Two great bodies of hardwood timber, however, remain, upon which comparatively slight inroads have yet been made. The most important of these forests covers the region occupied by the Southern Alleghany Mountain system, embracing south-western Virginia, West Virginia, western, North and South Carolina, and eastern Kentucky and Tennessee. Here oak unequalled in quality abounds. Walnut is still not rare, although not found in any very large continuous bodies, and cherry, yellow poplar, and other woods of commercial importance are common. The second great body of hardwood, largely oak, is found west of the Mississippi River, extending from central Missouri to western Louisiana. The forests of Michigan, especially those of the northern peninsula, still abound in considerable bodies of hardwood, principally maple. Throughout the remainder of the Atlantic region, the hardwood forests, although covering considerable areas, have everywhere lost their best timber, and are either entirely insufficient to supply the local demand of the present population, or must soon become so.

In the Pacific region, the great forests of fir which extend along the coast region of Washington Territory and Oregon, are still practically intact. Fire and the axe have scarcely made a perceptible impression upon this magnificent accumulation of timber. Great forests of pine still cover the California sierras through nearly their entire extent; the redwood forest of the coast, however, once, all things considered, the most important and valuable body of timber in the United States, has already suffered seriously, and many of its best and most accessible trees have been removed. This forest still contains a large amount of timber, although its extent and productive capacity has been generally exaggerated. The demand for redwood, the only real substitute for white pine produced in the forests of the United States, is rapidly increasing; and even at the present rate of consumption the commercial importance of this forest must soon disappear.

The pine forests which cover the western slopes of the northern Rocky Mountains, and those occupying the high plateau and inaccessible mountain ranges of central Arizona and south-western New Mexico have not yet suffered serious damage at the hands of man. The remaining forests of the Pacific region, of little beyond local importance, are fast disappearing. The area of these interior forests is diminished every year by fire, and by the demands of a careless and indifferent population, and their complete extermination is probably inevitable. The forest wealth of the country is still undoubtedly enormous. Great as it is, however, it is not inexhaustible, and the forests of the United States, in spite of their extent, variety and richness, in spite of the fact that the climatic conditions of a large portion of the country are peculiarly favourable to the development of forest growth, cannot always continue productive if the simplest laws of nature governing their growth are totally disregarded.

The judicious cutting of a forest, in a climate like that of the Atlantic or Pacific Coast regions, entails no serious or permanent loss. A crop ready for the harvest is gathered for the benefit of the community; trees which have reached their prime are cut instead of being allowed to perish naturally, and others take their place. The permanence of the forest in regions better suited for the growth of trees than for general agriculture may thus be insured. Two causes, however, are constantly at work destroying the permanence of the forests of the country and threatening their total extermination as sources of national prosperity—fire and browsing animals inflict greater permanent injury upon the forests of the country than the axe, recklessly and wastefully as it is generally used against them.

Michigan is the greatest lumber producing State in the Union. The value of its lumber product, with that of Wisconsin and Minnesota, exceeds one-third of the total value of all the lumber manufactured in the United States. This enormous development of the lumber business in the lake region is due to the excellence of its forests, the natural advantages of the country for manufacturing lumber, and the easy

communication between these forests and the treeless agricultural region west of the Mississippi River.

The extinction of the forests of the lake region may be expected to seriously affect the growth of population in the central portion of the continent. The country between the Mississippi River and the Rocky Mountains, now largely supplied with lumber from Michigan, Wisconsin and Minnesota, must for building material soon depend upon the more remote pine forests of the Gulf Region, or those of the Pacific Coast. A great development in the now comparatively unimportant lumber manufacturing interests in these regions may therefore be expected. New centres of distribution must soon supplant Chicago as a lumber market, and new transportation routes take the place of those built to move the pine, grown upon the shores of the great lakes. It is not probable, however, that any one point will ever attain the importance now possessed by Chicago, as a centre for lumber distribution. With the growth of the railroad system, and the absence of good water communication from the great forests remaining in the country, toward the centre of the continent, lumber will be more generally shipped by rail from the mills to the consumer than in the past. In this way the pine of Mississippi, Louisiana and Arkansas, will reach Kansas, Nebraska, and the whole country now tributary to Chicago. Western Texas and Northern Mexico will be supplied by rail with the pine of eastern Texas, and the prairies of Minnesota and Dakota must draw their lumber by rail, not as at present, from the pine forest covering the shores of Lake Superior, but from the fir and redwood forests of the Pacific Coast.

MAINE.

Total area, 19,000,000; forest area, 12,000,000 acres. The northern pine belt formerly overspread the State. Pine and spruce with a lesser amount of deciduous trees almost covered the State, but the original pine and spruce forests have been practically destroyed, with the exception of some scattered bodies of the original pine. Hemlock, birch, maple and oak are still common in districts inaccessible by rail. The lumber business of southern and central Maine attained its greatest importance as early as 1850. In that year spruce was for the first time driven down the Kennebec with pine, and the proportion of spruce to pine has since steadily increased, until in the season of 1879-80, only twenty per cent. of this lumber cut on that river was pine. The lowest point of productive capacity of the forests of Maine has probably been passed. The reckless disregard of forest property which characterized the early lumbering operations of that State, has been replaced by sensible methods for preserving and perpetuating the forest. This change in public sentiment in regard to the forests has followed naturally the exhaustion of the forest wealth of the State. As this disappeared the importance of preserving some part, at least, of the tree covering, the source of the State's greatest prosperity, forced itself upon public attention; for, unless the forests could be perpetuated, the State must lose forever all commercial and industrial importance. It has followed that the forests of Maine, as compared with those in other parts of the country, are now managed sensibly and economically. They are protected from fire, principally through the force of public sentiment, and only trees above a certain size are allowed to be cut by loggers, buying stumpage from the owners of land. In the southern counties the young pine now springing up freely on abandoned farming lands is carefully protected, and large areas are planted with pines in regions where the natural growth has not covered the soil. The coniferous forests under the present management, may be cut over once in every fifteen or twenty years, producing at each cutting a crop of logs equivalent to 1,000 feet of lumber to the acre, of which from five to seven per cent. is pine, the rest spruce. Forest fires, which formerly inflicted serious damage upon the forests of the State, are now of comparatively rare occurrence.

NEW HAMPSHIRE.

Total area, 5,763,200; forest area, 3,000,000 acres. The forests of New Hampshire were originally composed of a belt of spruce mixed with maple, birch and other hardwood trees, occupying all the northern part of the State and extending south-

ward through the central portion; the south-eastern part of the State and the region bordering the Connecticut River, were covered with forests of white pine, through which considerable bodies of hardwood were scattered. The original white pine forests of New Hampshire are practically exhausted, although, in the northern counties of the State there still remain a few scattered bodies remote from streams and of small size. Once, of great extent and importance, these forests have disappeared before the axe of the settler and lumberman, or have been wasted by forest fires. Large areas, however, once covered with forests of pine, have grown up again, especially in the southern part of the State, with this tree. The remaining forests of the State are composed of spruce, more or less mixed with hardwoods. In the northern part of the State, large areas of the original forests remain at a considerable distance from streams.

VERMONT.

Total area, 5,846,400; forest area, 1,900,000. The forests of Vermont are more generally deciduous than coniferous. Forests of spruce, however, spread over the high ridges of the Green Mountains. A forest of white pine once stretched along the banks of the Connecticut, and great bodies of this tree occurred near Lake Champlain. The white pine forests of the State are now practically exhausted, being represented by a small amount of second growth pine only. Dr. Hiram A. Cutting writes, that a commission, of which he is president, has been appointed to see to Forestry matters. The diminution of the streams, he says, is the most noticeable effect of clearing. The rainfall is not so regular as formerly. Sleighing is uncertain. The wind drifts the snow to the detriment of winter grain, the growth of which has been therefore almost abandoned. Grass is also injured thereby, and storms are much more severe.

MASSACHUSETTS, RHODE ISLAND AND CONNECTICUT.

Total area, 8,940,800; forest area, 1,850,000 acres. The original forest which once covered these States has disappeared, and been replaced by a second, and sometimes by a third and fourth growth of the trees of the northern pine belt. The area covered by tree growth in these States is slowly increasing, although with the exception of the young forests of white pine, the productive capacity of these woodlands is, in view of the heavy demands continually made upon them, especially by the railroads, rapidly diminishing. Abandoned farming land, if protected from fire and browsing animals, is now very generally, except in the immediate vicinity of the coast, soon covered with a vigorous growth of white pine. The fact is important, for this new growth of pine promises to give in the future more than local importance to the forests of this region. T. S. Gold, Esq., Secretary of the Connecticut Board of Agriculture, writes that many evils have followed the loss of the original forest, for which the newer and more scattered growth does not compensate. The new growth too, is apt to be repeatedly burned over, destroying the accumulated vegetable matter which held in store the rainfall, from which causes the streams are generally diminishing in flow and permanence. The wind too, now causes snow drifting in roads and neighbourhoods formerly quite free. The Board of Agriculture has recommended a bill on the matter for the action of the General Assembly, of 1886. It proposes to exempt from taxation for twenty years any fresh plantations of forest trees. To impose heavy penalties in connection with the unauthorized or careless kindling of fires in woodlands. To compel railroad companies to destroy or remove all combustible rubbish or dead herbage within their right of way, wherever within 100 yards of any woodland, and to allow any owner of woodland to arrest without warrant, and bring before a magistrate any person found violating the act.

NEW YORK.

Total area, 30,476,800; forest area, 8,000,000. The portion of the State north of the forty-third degree of latitude, including within its limits the elevated Adirondack region, was once covered with a dense forest of maple, birch, basswood, and other

Northern deciduous trees, through which were scattered spruce and pine. The low hills bordering the Hudson, and extending along the southern boundary of the State west of that river were covered with the coniferous species of the Northern Pine Belt. Over the remainder of the State the broad-leaved forests of the Mississippi basin spread almost uninterruptedly, except where an occasional sandy plain or high elevation favoured the growth of pines. The original forest still covers vast areas in the northern counties, and protects the hills through which the Delaware River forces its way in crossing the southern part of the State. With these exceptions, however, the forests of New York are now almost exclusively of second growth. With the exception of the spruce of the Adirondack regions, the forests of the State are no longer important as a source of general lumber supply, and many industries depending upon hardwoods have of late years decreased in importance, owing to the want of sufficient material, or have been forced to obtain their supply of timber from the west. White oak, largely consumed by the railroads, has become scarce, and has advanced at least fifty per cent. in value during the last twelve years. Elm, ash, hickory, and other woods are reported scarce in all parts of the State. In some parts, such as the valleys of the Au Sable, and the Saranac Rivers, white pines spring up numerously whenever permitted to do so, and I am told that farmers, realizing that much of their soil is not suitable for profitable agriculture, are seriously considering whether it be not to their highest advantage to surrender much of their land to timber growing, and encourage the growth of the more valuable species, such as white pine, white oak, etc. The lumber business of the upper Hudson has begun to decline; not that there was any necessity for a diminution of the yearly crop of logs from the field, if the forest could be protected from devastating fires. The lumberman leaves standing, as far as possible, the spruce trees too small for the axe, and these, the overshadowing growth being removed, grow with increased vigor, so that good crops of lumber could be harvested from the soil every thirty or forty years, were it not that over at least one-half of the area lumbered fire follows the axe, burning deep into the woody soil, and introducing an entire change of tree covering. Poplars, birches, and bird cherries, if anything, succeed the spruces and firs. From this cause alone the lumbering interest of the region must dwindle. A large area utterly unadapted to agriculture is being made desolate, and nearly valueless, and its streams, the feeders of the water privileges and canals below, become every year more and more slender and fitful. These fires are largely set by reckless sportsmen and hunters, with whom this region peculiarly abounds in summer. They are careless in their smoking; they neglect to watch and properly extinguish the fires lighted for camp and cooking purposes, and sometimes they even delight to set fire to the brushwood of lumbered land in lawless sport. Again, to some extent, a class of petty pioneers follow the lumbermen, obtaining for a trifling sum a title to a little land, or, squatting without rights, set fire to the dry brushwood left by the lumbermen, and allow the fire to spread at will, devastating thousands of dollars' worth of property, for the mere convenience of saving themselves the trouble of burning boundary strips round their fields, which might not cost them labour to the value of \$10. The laws of New York, in respect to the setting of forest fires, are totally inadequate to protect the forests. There is a region of forest lying north-westward of the mountains of the southern portion of Saint Lawrence and Franklin Counties, which has not yet been badly encroached upon by the axe and fire. The destruction of this forest would be a public calamity, so useless is the soil for any other purpose than the production of timber, and so harmful to the settled country below would be the consequences resulting from clearing it. This forest is, no doubt, capable of yielding perpetually, an annual crop double that now drawn from it. This estimate, of course, is based upon the supposition that fires are prevented.

NEW JERSEY.

Total area, 4,771,200; forest area, 2,330,000 acres. The original forests of New Jersey have disappeared, except from some of the highest and most inaccessible ridges situated in the north-western part of the State, and these, with the increased demands of the railroads for ties and other materials, are fast losing their forest covering.

The forests of New Jersey are insufficient to supply the wants of the population of the State, and nearly all the lumber it consumes is brought from beyond its limits. The forests of pitch pine, which once covered large areas in the southern counties, have now generally been replaced by a stunted growth of oaks, and other broad-leaved trees. The manufactures of cooperage stock, and other industries using hardwoods, have been largely abandoned, owing to the decrease of the local supply of timber.

PENNSYLVANIA.

Total area, 28,790,400 ; forest area, 7,000,000 acres. Pennsylvania once possessed large forests of white pine and hemlock, stretching over both flanks of the Alleghany Mountains, and extending from the northern boundaries of the State to its southern limits. East and west of the Alleghany region, the whole country was covered with a heavy growth of broad-leaved trees mixed with hemlocks, and occasional groves of pines. Merchantable pine has now almost disappeared from the State, and the forests of hardwood have been either replaced by a second growth, or have been so generally culled of their best trees that comparatively little valuable hardwood timber now remains. Large and valuable growths of hemlock, however, are still standing in northern Pennsylvania. From all parts of the State, manufacturers using hardwood report great deterioration and scarcity of material, and Pennsylvania, which, during the census year was only surpassed by Michigan in the value of its forest crop, must soon lose, with its rapidly disappearing forests, its position of one of the great lumber-producing States. Lumbermen agree that there was originally far more hemlock in this State than pine, and they speak of it now as inexhaustible, which is not strictly true, for it is doubtful if it holds out to supply the increasing drain made upon it by tanneries and saw mills for more than twenty-five years to come. Large quantities of hemlock have been wasted. Much that grew intermingled with the pine, has died after the pine has been removed, partly from exposure to fuller sunshine and droughts, and partly to forest fires induced by, and following lumbering operations.

Thomas J. Edge, Esq., Secretary Pennsylvania Board of Agriculture, writes :—

In a few cases care has been taken of limited forest areas in Pennsylvania, and, in most cases with reasonable success. The work has been mainly limited to the removal of underbrush, dead limbs, etc., in order to prevent loss by fire, which, with us, as with most others, is our main drawback to this species of improvement : do not know of any extensive new planting, and the work has been thus far confined to a greater care of the old.

The effect of the continued clearing off of our timber areas has not shown itself in the amount of *average annual* rain fall, but has unmistakably manifested itself in its distribution, and we are much more liable to protracted drought and heavy floods than formerly ; local rains are not so reliable as formerly, and severe, general storms are more common. The water rushes into our water-courses, and is lost to the soil, instead of sinking slowly in, and being gradually given up to our springs ; as much water passes down our rivers as formerly, but they are subject to much greater extremes.

Some lines of trees are planted as wind-breaks around houses and barns ; evergreens, principally white pine, are preferred for obvious reasons ; this practice is limited, however.

The action of the State Legislature has so far been confined to passing laws for the punishment of those who start fire in our forests, but as it is no one's business to enforce them, they are practically dead on our Statute books. Our railroad companies, by sparks from locomotives, annually destroy thousands of acres of valuable timber upon lands which are available for nothing else, and the law will not reach them.

Crops are badly affected by the extremes of dryness, and the excessive rain, to which I have before alluded ; otherwise, we do not note any material effect from the destruction of our timber, of which we still have about twenty per cent. of the whole area of our State ; having so much mountain land, our average is thus kept up ; thousands of acres are cut over, and left to grow up again ; they will, unless destroyed by forest fires, grow up again, and soon make fair timber, but of other growths and kinds ; when the pines and

softwoods are cut off, the oaks and hard woods usually follow them, and if again cut, the reverse takes place in the natural rotation.

The decreases of water in our streams is only shown by the extremes of lowness from long continued droughts, and great height from excessive floods; the average annual amount of water passing down does not appear to have been changed, or, at least, not perceptibly so.

Our people are, however, becoming aroused to the importance of the Forestry and timber questions, and various impracticable laws are annually offered to our State Legislature for action, and none of them become laws. We want to know, first, what can be done, and, second, how it can be best accomplished; system is necessary in the work, and will, sooner or later, be *forced upon us* in a way which we must notice, but our people are proverbially slow in any thing that affects the general welfare, or which does not directly appeal to their pockets and profits.

DELAWARE.

Total area, 1,254,400; forest area, 300,000 acres. The northern portion of the State was once covered with the deciduous forests of the Atlantic plain; conifers, except red cedar, were rare. In the southern portion various pitch pines flourished. These pine forests were long ago consumed, and are now replaced by a second growth, generally of the original species, and throughout the State the best hardwood timber has been culled from the forest. Large quantities of wheel and cooperage stock were formerly manufactured, but of late years these and other industries using the products of the forests have, for want of material, greatly diminished in importance. Manufacturers report a general scarcity of timber.

MARYLAND.

Total area, 6,300,400; forest area, 2,000,000 acres. The north-western portion of the State was once covered with forests of white pine, hemlock and birch; the central portion of the State with hickories, gums, oaks and other deciduous trees; the eastern peninsula largely with different species of pitch pine. In the mountains considerable bodies of the forest remain upon the highest and most inaccessible slopes. In the remainder of the State, where the land is not cleared for farms, it is now largely replaced by a second growth, or—the best timber at least—is everywhere culled. A large amount of cooperage stock was formerly manufactured, but this industry has greatly suffered from the deterioration and exhaustion of the local supply of timber; manufacturers report the best wood nearly exhausted, and the substitution of inferior brought from beyond the State.

DISTRICT OF COLUMBIA.

The original forest has disappeared from the District of Columbia, and been replaced by a second growth.

VIRGINIA.

Total area, 25,680,000; forest area, 13,000,000 acres. West Virginia, 15,772,800, and 9,000,000. Virginia yet retains many valuable hardwood forests. The inaccessible mountain region in the south-western part of the State has immense quantities of the original oak, hickory, walnut and cherry. Railroads have hardly penetrated, while the streams are unsuited to carry these hardwoods to market. The most valuable hardwood forest remaining on the continent exists in Virginia and some adjacent counties of Kentucky, Tennessee, and North Carolina. Wood-using manufactures are increasing in the State. The eastern counties were originally covered with the forests of the maritime belt, but from both the central and eastern portions of the State the original forest has almost entirely disappeared, and is replaced in parts by an inferior second growth principally of Jersey old field pine. There is some valuable pine among the hardwood. A letter from

the office of the Virginian Agricultural Department states that the subject of forestry preservation is becoming one of much interest to our people individually, but as yet has not impressed itself on our State legislation. It is hoped that something may be done in this direction by the legislature now in session, in connection with the reorganization of this department. While our territory is generally well-wooded, there are some portions of the State injuriously denuded.

NORTH CAROLINA.

Total area, 31,091,200 ; forest area, 18,000,000. The forests of North Carolina were once hardly surpassed in variety and importance by those of any other part of the United States. The coast region was occupied by the coniferous forests of the southern maritime pine belt ; the middle districts of the State by a forest of oaks and other hardwood trees, through which the old field pine is now rapidly spreading over worn-out and abandoned farming lands. The high ridges and deep valleys of the Appalachian system which culminate in the western part of the State are still everywhere covered with dense forests of the most valuable hardwood trees, mingled with northern pines and hemlocks. The inaccessibility of this mountain region has protected these valuable forests up to the present time, and few inroads have yet been made into their stores of oak, cherry, yellow poplar and walnut. The hardwood forests of the middle districts, however, have been largely removed or culled of their finest timber, although the area of woodland in this part of the State is now increasing. These new forests, usually composed of inferior pine, are of little economic value, except as a source of abundant fuel, and as a means of restoring fertility to the soil, preparing it to produce again more valuable crops. A larger proportion of the pine forest of the coast has been destroyed in North Carolina than in the other southern states. This part of the State has long been the seat of important lumbering operations, while the manufacture of naval stores, once almost exclusively confined to North Carolina, and always an important industry here, has seriously injured these forests. The original forests have been practically removed from the north-eastern part of the State, the great region watered by the numerous streams flowing into Albemarle and Pamlico sounds, and although some lumber, largely second growth pine trees of poor quality, is produced here, the importance of these forests is not great. The merchantable pine, too, has been removed from the banks of Cape Fear, and other rivers flowing through the southern part of the State, and although these streams still yield annually a large number of logs, they are only produced at a constantly increasing distance from their banks and with a consequently increasing cost for transport. Last year naval stores, *i. e.* turpentine, resin, tar, etc., were produced in this State to the amount of eight millions of dollars. Such a crop as this necessitates the boxing or cutting into for turpentine of the best trees on a thousand square miles of forest. Few of these are afterwards used for lumber. They blow down or are burnt by forest fires.

SOUTH CAROLINA.

Total area, 19,300,800 ; forest area, 9,000,000 acres. The forest of South Carolina much resembles that of North Carolina ; being more swampy, its forests both of pine and hardwood have been less disturbed. The pine belt of the coast in South Carolina, as well as through its entire extent from Virginia to Texas, suffer from fires set every spring by grazers for the purpose of removing the scanty herbage growing among the trees of this open forest. These fires run rapidly over the surface stripped by the fires of previous years of any accumulation of vegetable material, without inflicting any immediate injury upon the old trees of the forests unless a turpentine orchard is encountered, when the resinous surface of the boxes being once fully ignited, nothing can save the trees from total destruction. If the mature trees of the forest are not under normal conditions greatly injured, however, by this annual burning of the dead herbage beneath them, the forest itself as a whole, suffers enormously from this cause. Slight, and short-lived as these forests are, they destroy the vegetable mould

upon the surface of the ground, all seeds and seedling trees, and all shrubbery and undergrowth, which, in protecting the germination of the seeds, insures the continuation of the forest. They deprive the soil of fertility, and make it every year less able to support a crop of trees, and in thus robbing the soil they influence largely the composition of succeeding crops. Few young pines are springing up anywhere in the coast region to replace the trees destroyed, but where seedlings protected from fire appear upon land long subjected to annual burning, they are usually, although not universally, of less valuable species, and not the long-leaved pine which gives to the forest its principal economic importance. These annual fires are slowly but surely destroying the value of the southern pine belt. They destroy all seeds and seedling trees, the fertility of the soil, and its power to produce again valuable species.

GEORGIA.

Total area, 37,747,200; forest area, 18,000,000 acres. The northern counties of Georgia are covered with the forests of the Alleghany Mountain region, here and in northern Alabama reaching the southern limits of their distribution and considerably reduced in the number of species composing them, the pines, firs, beeches, and other northern trees being generally replaced by the broad-leaved species of the Mississippi basin. From the base of the mountains forests of oak mixed with pines extend southward, occupying the central portion of the State and mingling with the trees of the maritime pine belt, along its northern limits. In the southern and coast counties great areas of swamp are still covered with forests of cypress, protected by their inaccessibility from the attacks of the lumberman. The merchantable pine in the immediate vicinity of the principal streams and along the lines of railroad has been removed, and serious damage has been inflicted upon the pine forests of that State by the reckless manufacture of naval stores. Vast areas covered with pine, however, still remain, while the hardwood forests of the central and northern portions of the State contain a large quantity of the most valuable hardwoods. J. T. Henderson, Esq., Commissioner Department of Agriculture, Georgia, says, very little attention has been given to the subject of Forestry in this State, either by the State Government or by any organized effort on the part of the citizens. Originally the entire surface of this State was covered with a dense forest. In the middle portions the forest has been largely swept away as the lands were required for cultivation. No especial care is taken of the older forest except in cases where there appears to be an immediate necessity for such care in order to supply the wants of the farms in the very near future. Very many farms are now without sufficient timber to supply fencing materials. There is no evidence that any changes have been effected as yet in the rain-fall or temperature by the partial removal of the natural forests. It is believed that the streams have been rendered muddy, and therefore unfit for many of the better species of fish by the extension of the cultivated areas, and the corresponding contraction of the forest areas.

FLORIDA.

Total area, 34,713,600; forest area, 20,000,000 acres. The forests of the Southern Pine Belt cover the State as far south as Cape Malabar and Charlotte Harbour. The long-leaved pine is replaced along the sandy dunes and islands of the coast by oaks (of which the live oak alone is of commercial importance), scrub pines, and palmettos, while a deciduous forest, largely of northern composition, occupies the high, rolling lands in a large part of Gadsheiw, Leon, Jefferson, and Madison counties. The pine forests gradually decrease southwards in density and value, and south of latitude 29° N., are of little present commercial value. Forests of pitch pines (*Pinus Cubensis*), however, extend far south of the region occupied by the more valuable long-leaved pine, bordering the coast and covering the low ridges of the Everglades. Great areas of swamp occur everywhere through northern and central Florida, covered with forests of cypress, red cedar, gum, and bordered with magnolias, bays, and other broad-leaved evergreens; while the hummocks, on low elevations, covered with rich soil and everywhere common, bear oaks and other deciduous trees, often of great size. South of

Cape Malabar and Tampa Bay the character of the vegetation changes, and the North American arborescent species are replaced by the semi-tropical trees of the West Indies. The forests of Florida have not suffered greatly from fire. Much of the State is uninhabited and unfit for agriculture or grazing. The danger therefore of fires, set in clearing land for farms, spreading to the forest is less than in other parts of the south.

ALABAMA.

Total area, 32,985,600 ; forest area, 17,500,000 acres. The northern and north-eastern portions of Alabama, embracing the foot-hills of the southern Alleghany Mountains and the valley of the Tennessee River, are covered with a rich and varied forest growth of broad-leaved trees, in which oaks, hickories, ashes, walnuts, and cherries abound. South of the Tennessee River the rolling country is covered with oaks, through which belts of short-leaved pine occur. In Cherokee and Saint Clair counties, isolated bodies of long-leaved pine appear, while a narrow strip of the same species stretches nearly across the State, between the thirty-third and thirty-second degrees of north latitude. South of this central belt the country is again covered with forests of hardwood, which, farther south in the rolling pine-hill region, are mixed with a heavy growth of the long-leaved pine, and this species occupies, or once occupied, almost exclusively outside of the numerous river bottoms, the sandy plain extending along the coast, and reaching nearly 100 miles inland from the shores of the Gulf. The manufacture of wheel stock and cooperage, furniture, and all other articles of wood, is still in its infancy in Alabama and the other Gulf States. E. C. Betts, Esq., Commissioner of Agriculture, Alabama, writes: "Nothing has as yet been done by this State towards preserving or restoring our forests. There are probably something more than 3,000,000 acres of Government land covered with the original forest growth, and upon all tracts in private hands, there is more or less tinkered law. I think there has been a great increase in the last half a century in the amount of wind, which is chiefly made sensible by the promptness with which changes of weather, which take place on the lakes, are propagated in this direction; though I think that the snow-fall is less in the northern part of the State than it was in the early settlement of the country. I do not think there has been any observed decrease in the amount of rain-fall or in the water of our streams."

MISSISSIPPI.

Total area, 29,657,600 ; forest area, 13,000,000 acres. The forests of Mississippi originally extended over nearly the entire State. The forest consisted of a belt of long-leaved pine, occupying the coast plain and reaching from the eastern confines of the State to the bottom lands of the Mississippi River, and from the coast nearly to the line of Vicksburg and Meridian. The north-eastern portion of the long-leaved pine forest spreads over a high, rolling country, and here the pine were mixed with various hardwood trees; north of the long-leaved pine forest a long belt, gradually narrowing towards the north and occupied by a growth of short-leaved pine, and of hardwoods, reached nearly to the northern boundary of the State, while south of the Tennessee River, in Tishomingo, Prentiss, and Itawamba counties, a considerable area was covered with short-leaved pine. The remainder of the State was covered with a growth of hardwoods, which, in the swamps of the Yazoo delta and the bottom lands of the Mississippi River, formed a vast and almost impenetrable forest, where cypresses, gums, water oaks, ashes, and other trees which find their home in the deep, inundated swamps of the south Atlantic region, attained noble dimensions and great value. The hardwood forests, outside of the bottom lands, have been largely cleared from many counties in providing for the requirements of agriculture; but the long-leaved pine of the Mississippi is, however, still practically intact, and these forests are capable of supplying an immense amount of timber as soon as the means of transportation can be furnished for it. The forests which cover the swamps of the State are still almost intact, although the most accessible cypress, which has long been cut in the Yazoo delta, and the valley of the Pearl River, to supply the New Orleans market, has become scarce.

LOUISIANA.

Total area, 29,068,800; forest area, 13,000,000 acres. Louisiana was originally covered with a dense and varied forest growth. The Maritime Pine Belt covered the eastern portion of the State nearly to the Amite River, or until checked from further western development by the alluvial deposits of the Mississippi. Forests of pine, too, occupied the western part of the State north and south of the Red River. The pine flats of Calcasien were covered with forests formed almost exclusively of the long-leaved pine, which, farther north, mixed with oaks and various hardwood trees, extends over the high-rolling country which stretches from the Sabine north-easterly, nearly to the Onachita River. The north-eastern part of the State was covered, outside of the broad bottom lands of the rivers, with a heavy forest of short-leaved pine (*Pinus Mitis*), mixed with upland oaks, hickories, and other deciduous trees. The bottom lands, and all that part of the State bordering the Mississippi, were covered with a heavy growth of trees peculiar to such low, rich soil throughout the Gulf region. The high bluffs which occur at different points along the Mississippi, the Atchafalaya, and other streams flowing through the western part of the State, were covered with a noble forest of evergreen magnolias, mingled with beeches, water oaks, and gums. The most valuable forests of the State are still almost intact, although the pine has been cut from the banks of the Pearl River and some of its tributaries, and from along the line of the Chicago, St. Louis, and New Orleans Railroad, to furnish the New Orleans market with lumber, yet there are still vast forests of both long and short-leaved pine remaining. The magnificent hardwoods, common over much of the State, can supply abundant material for many important industries which, already at the north, suffer from the exhaustion and deterioration of the local timber supply.

TEXAS.

Total area, 167,865,600; forest area, 40,000,000 acres. A forest of long-leaved pine occupies most of the territory between the Sabine and the Brazos, south of the thirty-first degree of north latitude, reaching south to within twenty miles of the coast. Beyond the long-leaved pine forests, forests of the loblolly pines, mixed with hardwoods, stretch westward fifty or sixty miles; while north of these two regions a third division of pine belt, composed of a heavy growth of short-leaved pine, mingled with upland oaks, occupies the rolling ridges which extend northward to beyond the Red River. The pine belt covering the eastern counties of the State is alone important as a source of lumber supply. Areas of river bottom land, covered with trees, are, as compared with the area of the State, insignificant in extent, and these river belts of forest are entirely insufficient to supply even the mere local wants of the nearest settlements. The oak forests which spread more or less continuously between the eastern pine belt, and the treeless western forests and plains are, except along the extreme eastern borders, composed of small, stunted trees, often hollow, defective, and of little value, except for fuel, fence rails, and railway ties. The forests of the western mountain are not luxuriant, and at the best can only supply a limited local demand with inferior lumber.

INDIAN TERRITORY.

No returns of the amount of lumber manufactured in the Territory have been received, nor other than the most general information in regard to its forest covering; but we know that the bottom lands of all the streams, flowing through the eastern portion of the Territory, are heavily timbered with hardwoods, and especially Neosho, Verdigris, Arkansas, and Canadian Rivers, contain great bodies of the finest black walnut now growing. A particularly fine growth of this timber extends along the Verdigris River for fifty miles above Coffeetown. There are also in the Cherokee country some considerable bodies of pine.

ARKANSAS.

Total area, 33,948,800; forest area, 20,000,000 acres. With the exception of a few isolated prairies, heavy forests cover the State of Arkansas. North of the Arkansas

River they are mostly composed of the deciduous trees of the Mississippi basin. The south-western part of the State, south of the Arkansas River and west of the broad, level plain of the Mississippi, is covered outside the river bottom lands with an almost continuous forest of pine. Great bodies of cypress cover the extensive swamps. The hardwood forests of the State are hardly surpassed in variety and richness, and contain inestimable bodies of the finest oak, walnut, hickory, and ash timber. Black walnut of large size is still widely scattered over the State, and is particularly abundant in the valley of the Red and other southern rivers. The pine forests are almost intact. Settlements made for agricultural purposes have been confined to bottom lands, and only during the last few years has pine lumber been manufactured in the State, except to supply a very limited local demand. Recently, however, comparatively small quantities of lumber manufactured at numerous railroad mills, principally established south of the Arkansas River, have been shipped north and south out of the State.

TENNESSEE.

Total area, 26,720,000; forest area, 11,000,000 acres. The western counties of Tennessee are covered with heavy forests, similar in density and distribution to those which occupy the Yazoo region of western Mississippi. The eastern part of the state, occupied by the Cumberland plateau and the high ranges of the southern Alleghany mountains, is covered with a heavy forest of oak and other hardwoods, mixed at high elevations with hemlock, pine, and spruce, and constituting one of the finest bodies of timber, now standing in the United States.

KENTUCKY.

Total area, 25,600,000; forest area, 12,800,000 acres. A far greater proportion of Kentucky than of the States last described has been cleared. The eastern counties, however, still contain great bodies of black walnut, white oak, cherry, and yellow poplar of the best quality. These forests, protected by the falls of the Cumberland River, which have prevented the driving of logs from its upper waters, and inaccessible to rail communication, are still practically uninjured, and probably unsurpassed in the amount, quality, and value of the timber which they contain. The forests of Kentucky, as well as those of all the central and southern portion of the United States, suffer severely from the almost universal practice of using woodland for pasturage. The pasturage of woodland necessitates, or at least induces, the annual burning of the dead herbage, by which underbrush, young trees, seedlings, and seeds are destroyed, and the succession and permanence of the forest endangered. The injury, too, inflicted by the constant stamping of animals and consequent packing of the lands about the stems of old trees is very great, and all reports speak of the gradual dying of old trees left standing in the grazing regions of Kentucky and Tennessee. John T. Davis, Esq., Commissioner of Agriculture, Kentucky, says:—

As yet, no care has been taken in this State of any portion of our forests. On the contrary, the work of disforestation is still going on in almost every part of the State, but especially in the Mountain region; although the average percentage of forest in the whole State is believed to be considerably below forty, while in the "Blue Grass Region," the boasted "garden spot of the continent," the average is down to about ten or twelve, considerably below the point of health and safety.

Unquestionably, here as elsewhere, the destruction of the forests has had a most injurious effect on the rainfall and on the climate generally. For example, here in Central Kentucky, where the forests have been reduced to two and four per cent., people are complaining more and more, every year, of the excessive summer drouths, and freshets, and of the increase in both the cold of winter and heat of summer.

Although our State Government has as yet done nothing to check the indiscriminate destruction of the forests; attention to the subject has been aroused in many quarters, and the imperious necessity of calling a halt is freely suggested.

OHIO.

Total area, 26,086,400; forest area, 4,500,000 acres. The original forest has now been generally removed; everywhere the walnut and other valuable timbers have been culled, and Ohio must soon depend almost exclusively for the lumber which it consumes upon the northern pineries, and the hardwood forests of the south. Ohio is sixth among the states in the volume of its lumber manufacturing interests. The business is widely distributed throughout the State, generally in the hands of small manufacturers operating portable mills, which threaten the rapid destruction of her forests.

INDIANA.

Total area, 22,982,400; forest area, 4,500,000 acres. Indiana was once almost entirely covered with noble forests of deciduous trees. These have been largely removed in the development of its agriculture. No large bodies of the original timber remain. The black walnut with which the forests of Indiana once abounded, has been everywhere culled, and is now bare, while the best yellow poplar, oak, and other valuable timbers have been largely consumed. The forests of Indiana have long supplied material for a large manufacture of cooperage stock, furniture, waggon stock, woodenware, etc. The cooperage and furniture manufacture already feel the scarcity and deterioration of the highest grades of oak and walnut, and very generally predict the entire exhaustion at no very distant day of the forests of the State; at the present rate of destruction these must soon lose all commercial importance.

ILLINOIS.

Total area, 35,840,000; forest area, 3,500,000 acres. The forests of Illinois were originally confined to the southern portion of the State, the broad bottom lands of the Mississippi and the Illinois, and the southern third of the delta formed by these rivers. The remainder of the State was covered with broad rolling prairies. The forest growth in the prairie region was confined to the narrow river bottoms and occasional open park-like groves, through which the prairie fires swept, destroying all undergrowth, without doing great injury to the full-grown trees. Prairie fires have gradually decreased in frequency and violence since the settlement of the State, and these open groves are now filled with a vigorous growth of young seedlings and shoots; their characteristic features have disappeared, and the area of the forest is gradually increasing. The forests of Illinois are generally composed of deciduous species. The production of cooperage stock was once an important industry in southern Illinois. The business has greatly diminished owing to the exhaustion of the local supply of the best hardwoods. Bass, gum, hackberry, elm, sycamore, and other woods, formerly considered of little value, are substituted for oak, and Illinois now receives most of its hardwood from Kentucky, Tennessee and other southern States.

MICHIGAN.

Total area, 36,755,200; forest area, 14,000,000 acres. Michigan once possessed a tree covering of great richness, density, and variety. The hardwood forests of the Ohio valley covered the southern portion of the State, extending to just north of the forty-third degree of latitude. North of this hardwood belt the character of the forest changed; the white pine disappeared, and, gradually increasing in size and frequency, became the most important element in the forests of the central and northern portions of the southern peninsula. In the northern peninsula it covered the sandy plains almost to the exclusion of other species. Serious inroads have already been made upon the forests of Michigan. The hardwood has been generally cleared from the southern counties, and the timber remaining in that part of the State can hardly suffice for the wants of its agricultural population. The merchantable white pine has been cut from the banks of its principal streams, and the shores of the lakes, and what now

remains is remote from water transportation or scattered in bodies of small extent. The hardwood forests of the pine belt, however, although greatly injured by fire and invaded by settlement, contain vast quantities of valuable timber. The forests of Michigan have long suffered from destructive fires. The reason is obvious. The logger in his operations, leaves the resinous tops, branches, and chips, which afford abundant material to feed a fire started by a careless hunter or squatter clearing land near the forest. These have done vast injury, they have destroyed great hardwood forests, burnt the young pines left by the logger, robbed the soil of its fertility, and made it unfit to produce another crop of pine till the decay of generations of other plants shall have restored its lost constituents to the soil. In the dense, unculled forest, on the other hand, fires, though often destructive, are less dangerous in the absence of material to feed the flames than when the ground is strewn with chips, branches, and lumbermen's rubbish. The hardwood forests of Michigan have long afforded abundant material for large and important industries, but wood-workers now report a scarcity and general deterioration of stock. The best oak timber has been everywhere culled to supply the wants of railroads or the demands of the Canadian market. Elm, bass, and other soft woods, which a few years ago were considered of little value, are now in great demand and fast disappearing, except in regions remote from railroads. Much hardwood has been destroyed by fire, or if not destroyed, rendered almost worthless by partial burning.

WISCONSIN.

Total area, 34,848,000; forest area, 17,000,000 acres. About one-half of Wisconsin is still forests, originally of mingled pine and hardwood, but from much of this the pine has been taken. The pine has been destroyed along the entire southern borders of the pine belt, along the banks of the principal streams and from the lines of railroads, while the hardwood has been often greatly injured or destroyed by fire in those parts of the State where pine has been cut. The amount of pine still growing in Wisconsin is nevertheless large, although it should not be forgotten that the best and most easily accessible has already been harvested. What remains is generally remote from actual lines of transportation, and often, especially in the extreme northern part of the State, of comparatively poor quality. The loss by fire is large. The lumbermen waste the log which runs into the top of the tree; this is knotty, but usually sound, and would make good merchantable lumber. It is left in the woods, however, because there is a good deal of work in trimming the knots and cutting off the limbs. From an ordinary sized tree, four sixteen foot logs are usually taken, the rest being left. Often this top log is twenty-two inches in diameter at the butt, and will scale from 100 to 120 feet. Loggers are paid so much per thousand feet by the lumbermen, and the amount they receive is so small, that they cannot afford to spend the time to finish up and take out the fifth or last log, which is therefore left in the woods and lost. As a matter of fact, more than half the area from which pine forests have been cut in the north-west, is sooner or later burned over. The fire destroys the young trees and changes the nature of the surface of the ground, so that the infant crop which comes up consists of briars and poplars, and then hardwoods. When pine is cut off or burned it does not come up again, and I have never seen any old choppings of pine come up with pine again, even when some trees were left, and the ground had not been burned, although where a few large trees only are removed from a pine forest growing on a rich soil the small trees left standing, if protected from fire, will continue to grow.

MINNESOTA.

Total area, 50,591,200; forest area, 22,000,000 acres. About two-fifths of the State is forest, much of which is more or less cut over or of inferior quality. The pine has been removed from the principal streams of the State, and that which remains, except in the region tributary to Lake Superior, and in the vicinity of the Red Lake, is now inaccessible or of comparatively little value. The best hardwood forests of the State,

as in Michigan and Wisconsin, have suffered seriously by fires started in abandoned pineries, or in clearing land for agriculture.

IOWA.

Total area, 35,504,000 ; forest area, 2,300,000 acres. Iowa, a prairie State, has but twelve per cent. of forest. Since the first settlement of the State, the forest area has been increased by the natural spread of trees over ground protected from fire, and by considerable plantations of cottonwood, maple, and other trees of rapid growth made by farmers, to supply fuel and shelter. The natural forests have been everywhere largely culled of the most valuable timber, and in spite of their increased acreage are, in their commercial aspect, in danger of speedy extermination. Manufacturers of cooperage stock, and others using Iowa timber, report great scarcity and deterioration of stock.

MISSOURI.

Total area, 43,990,400 ; forest area, 16,000,000 acres. Missouri still contains one-third of nominal forest area, and the forest of south-eastern Missouri still possess great stores of valuable timber, although the best trees have been cut in the neighbourhood of all settlements, and for a distance varying from five to twenty miles back from all lines of railroad. This is especially true of the best white oak, and of black walnut, once common, and now almost exterminated in all parts of the State. A gratifying improvement in the condition of the forests in the parts of the State first settled, has followed the enactment of a fence law, preventing the general ranging of stock through the timber land. A young growth has sprung up among the older trees and along the borders of woodlands protected from browsing animals, and these young forests are valuable in their prospective yield, and, as an indication of the methods which must be adopted to preserve and perpetuate the forests of the whole Atlantic region.

DAKOTA, NEVADA AND IDAHO.

Total area, 218,707,200 ; forest area, 15,000,000 acres. Dakota, with the exception of its river lands and the small territory between and south of the forks of the Cheyenne River, is practically destitute of lumber. The bottoms of the principal streams contain extensive groves of hardwood. The great development of mining in Nevada has nearly exterminated its scanty forests. Idaho has one-fifth forest. The Bitter Root, Cœur d'Alene and Salmon River Mountains, as well as the slopes of the Rocky Mountains here, are wooded, some heavily so, with pine, fir and larch, but no full reports have been as yet received.

WASHINGTON.

Total area, 42,803,200 ; forest area, 20,000,000 acres. Most of it is of poor quality, but west of the Cascade Mountains is the heaviest continuous belt of forest in the United States, mostly of red and yellow fir, while red cedar and hemlock are common. The quantity of merchantable timber standing here, though no calculation is possible with present knowledge, must be enormous, a yield of 200,000 feet to the acre is not uncommon, while over fully 20,000 square miles a yield of 25,000 feet to the acre might be expected. The method adopted by the lumbermen are wasteful in the extreme.

OREGON.

Total area, 60,518,400 ; forest area, 20,000,000 acres. The heavy timber mentioned above, extends here also west of the Cascades, while east of these it is light as in Washington. Its forests have, however, suffered heavily from fires. Its abundant spruce, ash, cedar, maple, alder, and cottonwood have developed flourishing industries.

CALIFORNIA.

Total area, 99,827,200 ; forest area, 20,000,000 acres. The heavy forests are confined to the coast range, the slopes of the Sierra Nevada, on the eastern side of the State, and the group of mountains joining these ranges on the north. The most valuable forest of the Sierra Nevada consists of the sugar pine, the yellow pine, and the red fir. The western slopes below 4,000 feet elevation are clothed with pine of small value, and the broad valleys, between these great ranges, are here and there possessed of groves of oaks of great size, but of little use except as fuel. The eastern slopes are heavily covered with yellow pine. On the coast from Monterey to the northern boundary, the belt of redwood is the most important forest of similar extent now standing. Few trees equal the redwood in economic value. No other forest can compare with this in productive capacity, and no other great body of timber in North America is so generally accessible or so easily worked. Trees producing 75,000 feet are not uncommon, while 1,000,000 to 2,000,000 feet per acre is by no means rare. Throughout the forest the redwood most accessible has been culled, but heavy bodies are still standing. The principal cutting is near shore, as the mountain streams are unsuited for rafting, carrying the logs in the rapid thaw and rush of spring torrents, far out to sea. Short railroads for the purpose are necessary, of which some are in use, and others projected. No estimate of pine in the State is now possible, but an enormous amount is still in the Sierras, which have been lumbered but slightly, the want of access preventing it, and these, if protected from fire, will long yield a pine supply to the whole coast. The Californian forests, however, suffer seriously by it. Great loss is inflicted by stockmen firing the Alpine pastures to improve the grass, which destroys much timber, and especially young trees, which do not grow again on these exposed slopes. The mountain forests, too, are much endangered by the immense herds of sheep and cattle driven there to graze. From the foot hills to the highest meadows every blade and seedling tree is devoured. The sharp hoofs tread out the roots of grasses and allow the surface earth to rush to the plain, choking the streams and preparing the way for the destruction of the whole Sierra forests, which is certain if the practice continues. The life of any forest in which young trees are destroyed is but the life of the older trees. Fire, a great demand for lumber, or insects may sweep these away, and there will be no young trees to replace them. It must likewise be remembered that this would greatly injure the agriculture of the whole State, which depends much on the streams whose head waters are here. Great waste is common in lumbering. A tree capable of giving 30,000 feet will often be felled, a few shingles made from the butt cut, and the rest left to rot. There is here little hardwood fit for cooperage; the oaks are not; hickory, elm, and ash are seldom found, and for this purpose the State imports from the Atlantic region. A forest department has recently been established, which is, its secretary (S. W. Forman, Esq.) writes, now engaged in prosecuting illegal cutters of wood or setters out of fire for grazing purposes. He considers that the permanency of the forests depends on the support the department receives from the people, and that, if not prevented the same causes—forest destruction—which has occasioned drouth and sterility in other lands will do it there. Wind-breaks, he remarks, have been planted by private owners, with great benefit to the crops on the fields sheltered.

ALASKA.

Little is known of her forests, but they are not supposed valuable.

PINE STANDING IN THE UNITED STATES.

(These are the figures of 1880—the latest obtainable.) There is, in some of the territories, more pine standing, but no calculation can be made of its amount before

further surveys. These figures give the principal bodies of pine, as they were five years ago. It must be remembered that the cut continually increases largely.

STATES.	Feet Board Measure.	Cut in 1880.
Maine (White)	475,000,000	138,825,000
Pennsylvania (white).....	1,800,000,000	380,000,000
North Carolina (long-leaved)	5,229,000,000	108,411,000
South Carolina (long-leaved).....	5,316,000,000	124,492,000
Georgia (long-leaved).....	16,778,000,000	272,743,000
Florida (long-leaved).....	6,615,000,000	218,054,000
Alabama (long and short-leaved)	21,192,000,000	245,396,000
Mississippi (long and short-leaved) ..	24,975,000,000	115,775,000
Louisiana (long and short-leaved) ..	48,213,000,000	84,591,000
Texas (long-leaved, short and loblolly)	67,508,600,000	274,440,000
Arkansas (short-leaved)	41,315,000,000	129,781,000
Michigan (white)	35,000,000,000	4,397,211,000
Wisconsin (white).....	41,000,000,000	2,097,299,000
Minnesota (white).....	8,170,000,000	540,997,000
California (redwood)	25,825,000,000	186,635,000

EVERGREEN WIND-BREAKS.

We know from long experience that the summer storms, the early frosts, and the fierce unrelenting winter blizzards do pass by fields surrounded by growing trees, uninjured and unscathed.—*Judge C. E. Whiting.*

Throughout a large extent of Ontario, considering how much is already cleared of the original forest, with the exception here and there, of some small portions, and the decaying condition of many of these, where cattle have been allowed to destroy all chance of forest perpetuation, it is plain, that unless trees be planted, the surface of the country must soon largely resemble a wind-swept plain. The resultant evils, agricultural and other, of this state of affairs cannot be too frequently impressed on our minds.

In our latitude, one of the principal of these, is necessarily, the additional cold experienced in winter. Every Canadian has observed, that in the absence of wind, a low thermometer is comparatively little noticed. In the deep forest where wind was not, and four feet of snow over-laid the ground, I have passed days, time and again, working without gloves, at twenty degrees below zero. "In the Arctic regions," says Dr. Kane, "I can stand a journey at forty degrees below zero, but remember, no wind."

An evil to agriculture, perhaps even greater in a treeless country, is found in the injurious dryness occasioned in the soil by an uninterrupted wind-course. When the reviving showers of summer fall on the thirsty ground, the beneficial result to vegetation is easily seen—it is well known and undeniable, and the farmer is apt to calculate how great would be the benefit if, for a week or two, his wheat and clover would thrive as they appear to have done within the last twenty-four hours. The fact is they would continue so to thrive, had we not interfered with those operations of nature, which, in this our climate of extreme heat and cold, are needed for the growing plant. When the protection afforded by forests is altogether destroyed, in a country like Ontario, the course of the wind over the surface of the land withdraws the moisture too rapidly from the soil. The moisture given by a summer shower in conditions favourable to agriculture should remain near the surface for a length of time, until dissipated by slow descent to

the water courses below, or gradual uprising to the air above. During this process of slow movement of moisture through the warm summer soil, growth proceeds with its utmost vigor, and one of the chief objects of partial shelter is to keep the ground in this favourable condition during the growing period.

When the earth is deprived of the natural shelter given by portions of forest, and the wind is allowed free course and play over the surface, the ground is rapidly dried, and the natural moisture too quickly absorbed in the following way. The soil parts with a portion of its moisture to the stratum of air passing immediately above, which passing on, is immediately succeeded by another body of air equally dry, which absorbs another portion, and this in its turn is succeeded by another. As long in fact, as the wind blows briskly across the soil, so long the process of evaporation continues, occasioning necessarily great loss of fertility, compared with that obtainable in better sheltered grounds. This cause has much to do with the often observed fact, that growth is by no means so strong, vigorous, or lucrative to-day, even on new land, in the same locality, as it used to be on similar soil, when the country had been recently settled, and sheltering forests existed in all directions.

We cannot at once, expect to see a general commencement to replace those portions of woods, which, long since cut down, experience teaches us had better have been allowed to stand. The work of replanting many thousands of acres would be vast. But there is a method whereby, without expense beyond a sum quite within the means of most agriculturists, much of the benefits formerly obtained by the forest shelter might be again secured, and yet the husbandman retain his acres for plough or pasture almost in undiminished extent. This method is simply the use of evergreen wind-breaks.

Whoever chooses to take a little time now for this purpose can, in a few years, have his farm protected on the north, west, or whichever are its most exposed sides, by beautiful walls of verdure, giving the property an additional value twenty times in amount that which the necessary time and labour will cost him, and giving a shelter from wind, a warmth in winter, and an increase in the return of many of his crops, far beyond what is generally imagined.

It is now that this pains should be taken, for our trees are not increasing. Many small forests, now giving shelter, are yearly being cut down, some because want of care has rendered them impossible now to preserve, some through a mistaken idea of getting more land for farming operations. Be it as it may, we have been finding year by year, the country become more and more destitute of shelter, and he who begins to protect his farm now, will certainly, in a few years, find such work the best investment he ever made, whether in the view of the better crops to be obtained, the greater comfort in a farm so sheltered, or the additional price to be had if he choose to sell.

It is not as if this was a new, an untried, or a but lately tried method. Letters have been received from nearly three hundred well informed residents in different parts of Ontario, stating that such protection is always, in their experience, beneficial, and often in the case of winter crops, increasing the yield one-half over those obtained close by, but in unsheltered parts of the same or other farms.

The planting of evergreens has not been so general as that of other trees in Ontario, as they have been considered more difficult of growth. This has arisen mainly from one fact connected with their planting, that is, the roots must not be allowed any chance of drying. These trees have a resinous sap, which, once dried, kills the life of the tree. It requires but little exposure to do this. If you bring an evergreen, in apparently good

condition, to the place where you want to plant it, and leave it exposed to sun and wind while you dig the hole, even that amount of drying will sometimes destroy its chance of strong life, or of any life. These roots are often hair-like in their size, and wind or sun chokes the tubes at once with solid resin, which no watering will soften or vitalize. Yet they can be, and are, often carried with perfect safety long distances, even round the world, well packed in damp moss. If you so receive them, plant them the instant you take them out of the moss. If you dig them, cover instantly with some cloth or rug, choosing, if possible, a cloudy still day, and keep them closely covered till the time of planting. It is well to dip them in thin mud, as elsewhere advised. With this care there is absolutely no difficulty in planting evergreens. It is being done every day—is done in the States, I am glad to say, by the hundred thousand plants, and failure is rare.

As for the time to plant them, the first week in June is an excellent time—so is the first week in August. Yet they have been and are planted at all seasons, when the ground is workable, and with success. But reason must be observed in planting. For instance, if you go to a deep poor sand for your plants. There they send their long hair-like roots far down—perhaps three feet—for nourishment. It is hard to transplant this lengthy mass so as not too greatly to shock its habit of growth. The moral is, if you go there, take the plants thence very young, before they can have sent out deep roots, transplant them into your garden, and in a couple of years you will have fine stocky plants fit for any purpose. But do not let this discourage you from taking them from any forest. In many localities you will find them—take those near the outskirts always—with excellent roots. I know many beautiful groves of pine in Ontario—many long stretches of windbreak now fifty feet in height—the pride of the farms they beautify—which were taken when two or three feet high from the forest without one per cent. of failure. I knew one instance where nearly eight hundred young pines were moved in early spring, one morning after a sharp frost, which had re-frozen the ground, previously thawed, an inch or so deep. These then cut round, brought up circular masses of earth three or four inches thick and eighteen inches wide, containing within plenty of root fibres. This was on loam, not sand, so there was much surface root. Of the eight hundred scarce half a dozen failed.

A very important matter is the preparation of the ground, and when our plantation is of such narrow proportions as a windbreak this is easily done. A few furrows of the plough in fall and spring, or in spring alone, harrow it properly, and the work is done. This statement is applicable to most farm soils in ordinarily good condition, but where the soil is rather intractable other means may be necessary. We must consider, that it is only one long narrow row of plants we are preparing for. If the soil be a hard, apparently poor red or white clay, it is undoubtedly difficult even with two ploughings to bring about exactly that condition of mellowness which we should desire for the reception of tender roots of young evergreens. They can be planted there, and they will grow and succeed there, but it will take time. There is a quicker method, and when we can, it is well to employ one, for life is short. This hard clay soil is not poor, it is too close and dense. If you have within reasonable distance some sand, whether it be sharp and white, apparently only fit for mortar, or whether it be red and mixed with humus, so that it be but sand. A few waggon loads of this drawn along the proposed line of your windbreak, and scattered two inches thick before you plough, would change your hard clay to soil soft enough for tree roots. Two waggon loads will do a hundred yards, or if the land be poor sand, and clay be near, white, red or blue, though it be the hardest and

poorest, applied in the same quantities, (break the lumps) it will do as much for the sandy soil, as the sand does for the clay one. But most soils will grow trees without.

There are different methods of rapidly planting these windbreaks. In the case of young plants, one is to run a furrow, two men then pass along, one with a bundle of plants under his arm, the other with a spade. He first places the plant in position presses and spreads its roots against the upright side of the furrow and holds it there, while the second throws earth against it with his spade, and presses it firmly and evenly with his foot. Another, still in the case of small plants, is to run no furrow, but set a line, along which, at proper intervals, one throws out a spadeful, the other sets the tree therein and holds it, while the first throws earth against it and presses it firmly. The third is in the case of larger plants. Here, three men are better employed, one in advance digs larger holes along the line, the second places a tree, spreads its roots more horizontally than in the former methods, while the third fills it up and treads it down.

It must be remarked that the time occupied depends on the size of the roots and the state of preparation of the soil. Farmers must judge whether the roots need more or less time to place them at the level they stood in their nursery or forest, and with their roots properly in contact with the soil. Some soils would need much more careful handling than others. But do the work well; it will pay.

The distance at which such evergreen trees should be planted is a matter for consideration. If you take the pines, planting even twenty feet apart would undoubtedly give, after a number of years, an efficient windbreak, for, say in twenty years, their branches would interlace. But by planting closer we may have a windbreak in a much shorter period. If we plant, say three feet apart, we can well, in a few years, take out and plant elsewhere every second tree, and this is preferable to planting them six feet apart at first, for each closely neighbouring young tree helps the growth of the other. Where plants are small, it would be better to plant them yet closer, and depend on the future for proper thinning. Then you can indefinitely extend your lines of trees, as you will have a number of well-grown plants five or six years old with fine large masses of fibrous roots, which, properly dug and planted, will then give you, in a very short time, as many beautiful rows of sheltering evergreens as your farm shall need, or, if you have more than you will then consider requisite, you can sell them for good prices to such of your neighbours as have been less provident. And there is too good reason to believe that by that time, considering the present process of tree denudation, the value of shelter will have so impressed itself upon the minds of the surrounding farmers that you will have a remunerative market for all you can spare.

With regard to the after treatment of these windbreaks, an evergreen never should be trimmed up, that is to say, it should always be allowed to throw out its branches close to the ground at will. Its lowest branches are naturally the longest when grown in the open, and its tendency there is ever to shade by its lower branches and to mulch the earth below them by the covering of its fallen needles.

As has been said, the planting of even a very long row of evergreen windbreak is a matter of but slight expense. The young trees can, in many instances, be procured from our forests, or the seed can be sown, the young plants the second year planted out in nursery beds, and the fourth in the windbreak, or the seedlings can be procured for a few dollars per thousand from nursery-men.

In planting windbreaks of cedar, the best specimens I have seen were planted much more closely than the pines or spruces, being left at two feet or even a less distance apart.

Following this will be found a list of pines, cedars and spruces best calculated for this purpose, their distinctive methods of growth, their favourite soil, and their means of propagation and culture. Where these are not fully stated in any instance, all particulars will be found in the list of trees at the end of the book :—

EVERGREENS.

Pinus Resinosa (Red Pine).—This tree delights in a dry, sandy, or gravelly soil, or in one formed from the debris of rock. It will, however, and does frequently in our forests, grow in others. I have seen large trees on clay loam.—*B.*

Pinus Austriaca, (Black Austrian Pine).—We have not found this tree at all particular in regard to soil, if it is not stiff and wet. The best specimens we have seen of it grew upon a sloping bank, where the soil was a light loam, and deep and porous. We have, however, seen thriving plantations of it on most kinds of land, but these were always made dry by drainage, if not so naturally. It is a tree well adapted to produce a great degree of shelter, as its massy foliage forms a great protection from winds, and its rapid growth insures this within a very short time after planting. This tree is readily known from all other pines introduced into this country by its very strong and robust habit of growth, by the stiffness and strength of the leaves, by their prickly points, and by the very decided dark appearance of the foliage over the whole tree.—*B.*

Pinus Sylvestris, (Scots Pine).—Leaves in pairs, rigid. Cones conico-ovate, acute, as long as the leaves, generally in pairs. We have seen the Scots pine growing on almost every variety of land ; but we are of opinion that a light, sandy, or gravelly loam, is, above all others, when perfectly dry, the most appropriate for the tree. As to situation, suffice it to say, that if the land on which the Scots pine is planted be dry, it will prosper in any site not too elevated and exposed for trees to succeed in this country.—*B.*

Pinus Strobus (White Pine).—The white pine will grow rapidly on light, poor, sandy soils, and there are millions of acres of such lands that could not be put to a better purpose than planting it with White pines.—*F.* The branches are in regular whorls ; and in young trees, and where openly exposed, they form a beautiful pyramid ; the foliage is brilliant, leaves slender, from three to four inches long, of a light bluish-green.—*W.*

Pinus Ponderosa (Heavy-Wooded Pine).—This tree has leaves from nine inches to a foot long. Branches are regularly whorled, horizontal, and inclined to droop. This tree has a noble appearance, even when young. It is from the north-west coast of America. Hard, and grows rapidly.—*W.* The soil for this species, as for most others of the pine tribe, should not be of a rich nature, as under such circumstances the pines generally grow too luxuriantly, and consequently do not ripen the points of their shoots sufficiently to resist the frosts of our winter.—*B.*

Pinus Pinaster, (Cluster Pine).—Leaves twin, roughish at edge. Cones oblong, conical, shorter than leaf, narrow at base ; scales echinate.—*B.* It thrives in deep, sandy land, and is said to perish in calcareous soils. Immense tracts of barren, drifting sand have been covered with this tree in France, which now yield abundant crops of inferior timber, fuel, and pitch.—*W.* Propagate from seed ; sow at the end of April ; transplant at one and two years.

Pinus Benthamiana (Bentham's Pine).—Leaves three in a sheath, thickly set on the branches, dark green ; generally from eight to eleven inches, stout, somewhat flat, with a slightly elevated rib running along their inner side. One of the hardiest, and most ornamental pines. Propagation same as the Scotch pine. Deep, free soil.

Pinus Laricio (Corsican Pine).—Leaves two in a sheath, lax, from five to seven inches long, dark green, often twisted, sheaths short. A beautiful tree of a pyramidal and open-branched form. Will grow on most soils. Hardy, but unsuited to high winds. A very rapid grower, making two or three feet a year. Propagation from seed.

Abies excelsa (Norway spruce fir).—Leaves scattered, quadrangular. Cones cylindrical, terminal, pendant, scales naked, truncate at the summit, flat. It flowers in May ;

its cones are ripened in the spring of the following year, soon after which they commence shedding their seeds. One of the best trees for shelter belts, on account of its tendency to spread out its lower branches, assuming naturally the pyramidal form; and it is also found that this plant bears clipping very well. Nothing can be more beautiful or more effective as a shelter, than the Norway spruce. The seed is propagated in the same manner as that of the *P. Sylvestris*, the seedling plants remain two years in the seed bed, but they generally require three years in the nursery rows before they are fit to be put in their final situations. They grow best in a moist, and moderately rich, but not wet soil.

Abies Canadensis (Hemlock Spruce Fir).—Grows well, and makes a fine spreading shelter tree on tolerably good soil, but will not succeed as well in the open, on poor hard clay, as it did in the original forest.

Abies Nigra (Black Spruce Fir).—Will form a rather tall, slender tree, with branches spreading horizontally, and frequently drooping at the ends, in the case of old trees. The stem is generally smooth, with a blackish bark, very straight, and diminishing regularly from the bottom to the top. The whole tree has an open and airy appearance, from light being admitted between the whorls of branches, which are never of a massy or heavy character, like those of the common spruce fir, but light and pointed, each tier showing the outline distinctly.—*B.* Both this tree and the one preceding stand the shears well; but, so far as I have seen, they must not be cut down to small hedges of six or eight feet high. They are trees fit for shelter-belts, and the effort to treat them as hedge-plants I have known kill them.

Abies Alba (White Spruce Fir).—This species is easily distinguished from all the other species of the family by the lighter colour of its leaves, which are of a somewhat hoary grey colour; forms a beautiful small tree. The proprietor who wishes to produce a rich colouring of foliage in any particular part of his grounds, has only to plant some dark-leaved pine in the background, the sugar-maple in the front of it, and the white spruce in front of the maple; and when these trees have attained some size, he will find the autumn colourings admirable—the yellow, red, and crimson of the maple, the very dark green of the pine, and the hoary grey of the white spruce blending so as to produce an effect indescribable, and beyond the art of the painter.—*B.*

Thuja Occidentalis, (White Cedar).—The trunk tapers gradually from the ground, and the branches are so arranged as to form a pyramidal tree with a broad base; the twigs are drooping, and all the branches have a flattened character. This is justly considered one of the best of American evergreens for general planting, on account of its adaptability to various situations. Since its native habitats are peaty swamps, and rocky cliffs, it will thrive in almost any situation; and its conical figure and rather free growth make a good effect. One of the characters that recommend this tree is, that it bears clipping, and hence it is well suited for ornamental hedges, and wind-screens, for which purpose it is generally used.—*W.*

Juniperus Virginiana, (Red Cedar).—Red cedar is one of our own most valuable evergreen trees; nothing can exceed its value for purpose of shelter. As an ornamental tree or large shrub it is of great value for grouping. This plant is highly esteemed in Europe, but quite too much neglected in our own country; perhaps because it is so common; its growth is rapid, and it is very hardy. The shelter and food which this cedar affords to the feathered friends of man, are a great recommendation to it, and should induce every farmer to plant the tree.—*W.*

The initials mark quotations from Messrs. Brown, Warder, and Fuller.

TREES OF ONTARIO.

In the following pages will be found a list, so far as can be drawn from the best authorities, supplemented by what assistance my own experience could give, of all trees native to Ontario, as well as some which have been imported, and are now becoming tolerably common here. While this list is possibly not complete, it is yet probably the most complete given in anything like so condensed a form, where shrubs are excluded. Here, the endeavour has been to describe those species which grow from the ground with a single stem, or, in fact, those which would be considered as trees, and not as shrubs. Where obtainable, with each is stated the kind of soil in which they flourish best, and directions as to their propagation from seed, cuttings, transplanting, or whatever method is thought best suited by the leading authorities. Those which have been consulted are the valuable descriptions in the forestry section of the late American census, by Mr. Sargent, and the works of Loudon, Brown, Spotton, Fuller, Warder, etc. The passages quoted from the last five are marked by the initial letter of their names. Statements of Ontario farmers are also given. Where the word "compact" is used, it does not refer to the structure of woods, but that they show no tendency to check or open in drying. Where four numbers follow each other, as in the butternut, 270, 181, 238, 205; the first gives its relative value as fuel, the second its elasticity, the third its ultimate transverse strength, the fourth its ultimate resistance to longitudinal crushing. The unit "1" would be the highest value; thus the white hickory is marked 12 in elasticity, or nearly the highest of known woods. The meter is somewhat more than one yard—in feet, 3.2808992, or 3 feet and about $3\frac{1}{2}$ inches.

MAGNOLIACEÆ.

Liriodendron Tulipifera. (Tulip Tree. Yellow Poplar.. White Wood.)

South-western through western New England; southward to northern Florida (latitude, 30°); west through New York, Ontario and Michigan to Lake Michigan; south of latitude $43^{\circ} 30'$; thence south to latitude 31° in the Gulf States east of the Mississippi River; through southern Illinois and south-western Missouri to Crowley's Ridge, north-eastern Arkansas.

One of the largest and most valuable trees of the American forests, thirty to sixty meters in height, with a trunk two to four meters in diameter (*Ridgeway*), rich woods and interval land, reaching its greatest development in the valley of the lower Wabash River and along the western slopes of the Alleghany Mountains in Tennessee, and North Carolina.

Wood, light, soft, not strong, brittle, very close, straight-grained, compact, easily worked; medullary rays numerous, not prominent; colour, light-yellow or brown, the thin sap-wood nearly white; specific gravity 0.4230, ash 0.23; largely manufactured into lumber and used for construction, interior finish, shingles, in boat building, and especially in the manufacture of wooden pumps, woodenware, etc.; varieties varying slightly in colour and density are recognized by lumbermen.

Liriodendrin, a stimulant tonic, with diaphoretic properties, is obtained by macerating the inner bark, especially of the root. 259, 124, 208, 229.

Grows to a great height in many parts of the western peninsula of Ontario. Leaves, large, truncate, or with a shallow notch at the end. Flowers, large, showy, solitary; petals greenish-yellow, marked with orange. Fruit, a dry cone, which, at maturity, separates into dry, indehiscent fruits like samaras.—*S.*

Seeds sown in fall, transplanted at end of first year, and again at two years. Soil, deep loam.

ANONACEÆ.

Asimina Triloba. (Papaw. Custard Apple.)

Western New York (Lockport and Monroe County); Ontario (Queenstown Heights); eastern and central Pennsylvania; west to southern Michigan, southern Iowa, and eastern Kansas (Manhattan); south to middle Florida and the valley of the Sabine River, Texas.

A small tree, sometimes twelve meters in height, with a trunk rarely exceeding 0.30 meter in diameter, or often reduced to a slender shrub; rich, rather low woods, reaching its greatest developments in the lower Wabash valley, and in the valley of the White River, Arkansas.

Wood, very light, very soft and weak, coarse-grained, spongy; layers of annual growth clearly marked by several rows of large, open ducts; colour, light-yellow, shaded with green, the sap-wood lighter; specific gravity, 0.3969; ash, 0.21. 277, 281, 293, 298.

Flowers, purple, appearing before the leaves; the three outer petals much larger than the three inner ones. Fruit, two to three inches long, edible.—S.

Readily propagated from seed or suckers, which usually spring more or less abundantly from the roots. Best planted in sandy peat, or deep sandy soil.

TILIACEÆ.

Tilia Americana. (Lime Tree. Basswood. American Linden. Lin. Bee Tree.)

Northern New Brunswick; westward in British America to about the one hundred and second meridian; southward to Virginia and along the Alleghany Mountains to Georgia and southern Alabama; extending west in the United States to eastern Dakota, eastern Nebraska, eastern Kansas, the Indian Territory, and south-west to the valley of the San Antonio River, Texas.

A large tree, twenty to twenty-four meters in height, with a trunk 0.90 to 1.20 meter in diameter, or, exceptionally, thirty to forty-five meters in height, with a trunk 0.92 to 1.84 meter in diameter (valley of the lower Wabash River, Ridgway); common in all northern forests, and always an indication of rich soil; towards its western and south-western limits only along river bottoms.

Wood, light, soft, not strong, very close grained, compact, easily worked; medullary rays numerous, rather obscure; colour, light-brown, or often slightly tinged with red, the sap-wood hardly distinguishable; specific gravity, 0.4525; ash, 0.55; largely used in the manufacture of woodenware and cheap furniture, for the panels and bodies of carriages, the inner soles of shoes, in turnery, and the manufacture of paper-pulp (the quickly-discoloured sap renders it unfit for making white paper).

The inner bark, macerated, is sometimes manufactured into coarse cordage and matting; the flowers, rich in honey, highly prized by apiarists.

Aqua tilie, an infusion of the flowers, buds and leaves of the different species of *Tilia*, is used in Europe as a domestic remedy in case of indigestion, nervousness, etc. 246, 161, 241, 240.

Flowers, yellow or cream coloured, very fragrant. Leaves, smooth and green on both sides, obliquely cordate or truncate at the base, sharply serrate. Sepals, five. Fruit, a globular nut, one-celled, one-seeded.

Seeds sown in rows in October, transplanted at end of first year, and again at two or three years. Soil, rich, dry loam.

The basswood is one of the most beautiful trees that we have, but the seedlings are scarce in the forest, and therefore not many, comparatively, have been planted. Aside from its great beauty it deserves particular attention, as it is probably the greatest honey tree in the world.—F. Malcolm, *Innerkip*.

Our common basswood, linden, or lime tree, of the Atlantic States and Canada, is by far the most widely distributed of the four species found native in the United States. It grows to a large size, but when old is very apt to become hollow. The wood is very light, white, uniform in texture, not liable to crack or split, is quite tough, and when

sawn into thin boards may be readily bent into curves. It is much prized for cabinet wares and the panels of carriages, and its lumber is much used for carving and for finishing the inside work of houses, but it does not bear exposure to the weather well unless painted. When thoroughly seasoned and painted it makes an excellent material for outside work, as it receives and holds the paint well. The basswood loves a deep, rich and humid soil, and under favourable conditions it grows quite rapidly. It is generally considered an indication of a good soil. It seldom occurs in groves by itself, but is scattered among other deciduous trees, often in clumps, as if from sprouts that have come up around a tree that has decayed. It is easily cultivated from the seed, which should generally be planted in the autumn of the same year that they ripen. For ornamental planting they should be started in seed-beds, and then transplanted into nursery rows.

RUTACEÆ.

Ptelia Trifoliata. (Hop Tree. Shrubby Trefoil. Wafer Ash.)

Ontario and New York (banks of the Niagara River); Pennsylvania; southward to northern Florida; west to Minnesota and the headwaters of the Canadian River; through western Texas to the valley of the Mimbres River, New Mexico (*Bigelow*), and southward into northern Mexico.

A small tree, sometimes four to six meters in height, with a trunk 0.13 to 0.20 meter in diameter, or more often reduced to a slender shrub; shady, rocky hillsides. Seed ripe in October; sow same fall in loam, and keep well mulched.

SAPINDACEÆ.

Negundo aceroides. (Box Elder, Ash-leaved Maple.)

Shores of the Winooski River and Lake Champlain, Vermont, near Ithaca, New York, eastern Pennsylvania, and south to Hernando County, Florida (not detected in northeastern Florida); northwest through the lake region of the United States and Manitoba to the Dog's Head, Lake Winnipeg, and along the southern branch of the Saskatchewan to the eastern base of the Rocky Mountains; west in the United States to the eastern slopes of the Rocky Mountains of Montana, through Colorado to the Wahsatch Mountains, Utah; southeast through the basin of the Mississippi River, western Texas, and New Mexico to the Mogollon Mountains, eastern Arizona; southward into Mexico.

A tree fifteen to twenty-two meters in height, with a trunk 0.60 to 0.90, or, exceptionally, 1.20 meter in diameter; moist soil, borders of streams, etc.; in the Rocky Mountain region in high valleys, between 5,000 and 6,000 feet elevation; one of the most widely distributed trees of the American forest, reaching its greatest development in the valleys of the Wabash and Cumberland Rivers.

Wood, light, soft, not strong, close-grained, compact; medullary rays numerous, thin; colour creamy white, the sap-wood hardly distinguishable; specific gravity, 0.4328; ash, 1.07, occasionally used in the interior finish of houses, for woodenware, cooperage and paper-pulp.

Small quantities of maple sugar are sometimes obtained from this species. Grown from seed, which ripens in August, and should be sown as soon as possible, or from layers.

"The wood has a fine, even grain, and is saffron coloured, slightly mixed with violet, but is rather tender. The proportion of the alburnum to the heart-wood is large, except in very old trees, in which the heart-wood is variegated with bluish and rose-coloured veins. In America it is seldom employed for any other purpose than that of fuel; but in Europe it is used for cabinet-making, particularly for inlaying. It works well, is elastic, and sonorous. In England it is solely to be considered as an ornamental tree; and there, as well as in the United States, it merits the attention of cultivators and amateurs, in situations where immediate effect is the object; for it is rapid in its growth, showy in its appearance, by the fine green of its shoots, its large pinnate leaves which move by the slightest breeze, and its wide-spreading summit. It also merits attention from its faculty of growing in almost any kind of soil."—*B.*

Acer Pennsylvanicum. (Striped Maple, Moose Wood, Striped Dog-wood, Goose Foot Maple, Whistle Wood.)

Valley of the St. Lawrence River (Ha-Ha Bay), northern shores of Lake Ontario, islands of Lake Huron, south through the northern Atlantic States, and along the Alleghany Mountains to northern Georgia, west through the lake region to northeastern Minnesota.

A small tree six to ten meters in height, with a trunk 0.15 to 0.20 meter in diameter; cool ravines and mountain sides.

Wood, light, soft, close-grained, compact, satiny; medullary rays numerous, thin; colour light brown, sap-wood lighter; specific gravity, 0.5299; ash, 0.36. Sow in fall on loamy soil.

Acer spicatum. (Mountain Maple.)

Valley of the St. Lawrence River, west along the northern shores of the great lakes to northern Minnesota, and the Saskatchewan region, south through the northern States, and along the Alleghany Mountains to northern Georgia.

A small tree sometimes eight to ten meters in height, with a trunk 0.15 to 0.20 meter in diameter, or often a tall shrub; cool woods and mountain ravines, reaching its greatest development on the western slopes of the Alleghany Mountains of North Carolina and Tennessee.

"Wood, light, soft, close-grained, compact; medullary rays inconspicuous; colour, light brown, tinged with red, the sap-wood lighter; specific gravity, 0.5330; ash, 0.43; leaves three lobed, coarsely serrate, the lobes taper-pointed. Flowers greenish, appearing after the leaves, in dense upright racemes. Fruit with small, widely diverging wings. Sow as last."—S.

Acer saccharinum. (Sugar Maple, Sugar Tree, Hard Maple, Rock Maple.)

Southern Newfoundland, valleys of the St. Lawrence and Saguenay Rivers, shores of Lake Saint John, west along the northern shores of the great lakes to Lake of the Woods, south through the northern States, and along the Alleghany Mountains to northern Alabama, and the Chattahoochee region of west Florida, west to Minnesota, eastern Nebraska, eastern Kansas (rare), and eastern Texas.

A tree of great economic value, twenty-four to thirty-six meters in height, with a trunk 0.60 to 1.20 meter in diameter, or toward its southwestern limits greatly reduced in size; rich woods often forming extensive forests, and reaching its greatest development in region of the great lakes.

Wood heavy, hard, strong, tough, close-grained, compact, susceptible of a good polish; medullary rays numerous, thin; colour light brown, tinged with red; the sap wood lighter; specific gravity, 0.6912; ash, 0.54; largely used in the manufacture of furniture, shoe lasts and pegs, saddle-trees, in turnery for interior finish, and flooring in ship-building for keels, keelsons, shoes, etc., and furnishing valuable fuel; "curled" maple and "birdseye" maple, accidental forms in which the grain is beautifully curled and contorted, are common, and highly-prized in cabinet-making.

Maple sugar is principally made from this species; the ashes of the wood, rich in alkali, yield large quantities of potash. 117, 9, 18, 30.

"A fine tree, with three to five lobed leaves, a paler green underneath, the sinuse rounded, and the lobes sparingly sinuate-toothed. Flowers greenish yellow, drooping on slender hairy pedicels, appearing at the same time as the leaves. Calyx fringed on the margin."—S.

Seeds sown in fall, soon as ripe—transplanted at end of first year, and again in third year. Soil, rich and rather light. Loves thoroughly drained soil; does best on gravel ridges or on rock, if there be soil enough for root hold. I have seen good groves on sand hills.—D. Schooley, Ridgeway.

Will grow on any soil high enough to be dry, from stiff clay to pure sand. Have seen them four feet in diameter on sandy land, so light that when cleared it would scarcely grow anything. But this is not the rule; they grow best on loam. Isolated trees I find grow one inch in diameter a year.—*Thos. Baird*, Bright, Oxford.

Transplant well; but are subject to one trouble—a blight or sun-scald—the bark drying and parting from the tree, caused, I think, by the tree being accustomed to the shade of others, and unable to endure the sun. Sowing in beds, or taking the forest seedlings when three to six inches high to nursery rows, where they may be transplanted with safety, is the best plan. The common mistake is to plant too large. Given two trees newly set out, one $\frac{3}{4}$ inch diameter, and four feet high, one three inches diameter and of corresponding height; in five years the first will be by far the better tree.—*H. Westney*, Highland Creek, York.

Do not consider bush seedlings as good as those raised from seed; need more attention in transplanting, and the first are more likely to be injured by the sun. All trees should be well mulched.—*John Gillespie*, Galt.

Enjoys both the heat of the sun and dryness of the atmosphere better than any other variety; is nearly free of insects.—*W. Gorman*, Eden Grove.

I would notice one thing concerning maple sugar bushes, I have observed many of them kept with considerable care, every tree and shrub weeded out, thus leaving the trees scattered and thin, drying up and withering by degrees, until ultimately there are none left; the continual tread of cattle keeping down all sprouts, and the tough grassy sod getting master of the situation. The cause appears to be exposure to wind, having mulch of leaves taken away from their roots, the grass taking firm hold of the surface of the ground, there being no shrubbery to prevent. I have noticed to-day, a bush, from which the cattle have been shut for some time, making a good show of young brush, excepting the thin edge where the grass took a firm hold.—*M. J. Fisher*, Maxville.

The wood of the *acer saccharinum*, when newly cut, is white, but after being wrought and exposed for some time to the light, it takes a rosy tinge. Its grain is fine and close, and when polished, its lustre is silky. It is very strong and heavy, but wants the property of durability, for which the English and American white oaks are so highly esteemed. The northern wood, when dry, weighs forty-six pounds to a cubic foot, but that grown south, weighs much less. When properly dried it makes excellent fuel. When exposed to the alternations of moisture and dryness, it soon decays, and for this reason it is not much used in civil and naval architecture. In Maine, New Hampshire, Vermont, and farther north, where the oak is not plentiful, the timber of this tree is substituted for it, in preference to that of the beech, the birch, or the elm. When perfectly seasoned, which requires two or three years, it is used for axletrees, spokes, runners of common sleds, mill-cogs, and for chairs and cabinet work. It is also sometimes used for the frames of houses, keels, and the lower frames of vessels, piles, and foundation pieces for mills, canal locks, and for many other purposes where strength is required, and the work is not exposed to the alternations of moisture and dryness. The wood of this tree exhibits several accidental forms in the arrangement of its fibres, of which cabinet-makers take advantage in manufacturing beautiful articles of furniture, such as bedsteads, writing-desks, and other fancy work, and for inlaying mahogany and black walnut, in bureaus, piano-fortes, etc. These forms of varieties may be classified and described as follows:

1. Curled maple.—The undulation or medullary rays of this variety, like those of the red flowered maple, are lustrous, and in one light appear darker, and in another lighter than the rest of the wood. Sometimes the zigzag lines are crossed by beautifully coloured veins; but unfortunately, the lustre of these shades disappear by long exposure to light and air.

2. Bird's eye maple.—This variety exhibits small spots or eyes, not exceeding a tenth of an inch diameter, sometimes occurring a little way apart, and at others, contiguously disposed. The more numerous these spots, the more beautiful and valuable the wood. They are seen only in old trees, which are still sound, and appear to arise from an inflection of the fibres from the centres of their trunks towards the surface across the grain. To obtain the finest effect, the wood should be sawed as nearly as possible in a direction parallel with the concentric circles.

Acer dasycarpum. (Soft Maple, White Maple, Silver Maple.)

Valley of the St. John's River, New Brunswick, to Ontario, south of latitude 45° south to Western Florida; west to Eastern Dakota, Eastern Nebraska, the valley of the Blue River, Kansas, and the Indian Territory.

A large tree, 18 to 30, or exceptionally, 36 meters in height, with a trunk 1.20 to 1.80 meter in diameter; along streams and intervalles, in rich soil; most common west of the Alleghany Mountains, and reaching its greatest development in the basin of the lower Ohio River.

Wood, light, hard, strong, brittle, close-grained, compact, easily worked; medullary rays numerous, thin, specific gravity, 0.5269; ash, 0.33; somewhat used in the manufacture of cheap furniture, for flooring, etc.; maple sugar is occasionally made from this species. 192, 59, 53, 103.

"Leaves, deeply five-lobed, the sinuses rather acute, silvery white underneath, the divisions narrow, sharply toothed. Flowers in erect clusters, greenish yellow, appearing much before the leaves; petals none. Samara very large, woolly when young. Requires good rich soil. Seeds ripen early. If sown immediately will produce plants two feet or more in height the first season."—S.

The soft maple is a tree next to the hard maple most easily obtained. It is a rapid grower, suited for a great variety of soils, but is not so beautiful and useful as the sugar maple.

Acer rubrum. (Red Maple, Swamp Maple, Soft Maple, Water Maple.)

New Brunswick, Quebec and Ontario, south of latitude 49°, north and west to the Lake of the Woods, south to Indian and Caloosa Rivers, Florida, west to Eastern Dakota, Eastern Nebraska, the Indian Territory, and the valley of the Trinity River, Texas.

A large tree, twenty to thirty, or, exceptionally, thirty-two meters, in height, with a trunk 0.90 to 1.50 meters in diameter; borders of streams and low, wet swamps, reaching its greatest development in the valleys of the lower Wabash and Yazoo Rivers.

Wood, heavy, hard, not strong, close-grained, compact, easily worked; medullary rays numerous, obscure; colour, brown, often tinged with red, the sap-wood lighter; specific gravity, 0.6178; ash, 0.37; largely used in cabinet-making, turnery, and for woodenware, gun stocks, etc.; an accidental variety with undulating grain is highly valued.

Ink is occasionally made, domestically, by boiling the bark of this species in soft water, and combining the tannin with sulphate of iron; formerly somewhat used in dyeing. 154, 117, 121, 133.

"Leaves three five-lobed, the sinuses acute. Flowers red, appearing much before the leaves. Petals linear—oblong. Samara small and smooth, on drooping pedicels. —S."

Seeds ripen early. Naturally found in swamps, but will thrive in moderately dry soil. Sow as soon as they fall, and use the plants for all ground too wet for hard maple.

"This species, when cultivated, contrary to the general character of the maple, is said to thrive best in moist soil, which must, however, at the same time, be rich; and for the tree to attain a large size, the situation should be sheltered. In Britain it is chiefly propagated by layers; but on the Continent, almost always by seeds, which ripen before midsummer, and, if sown immediately, will come up the same season, to be transplanted in the spring. The wood of the red maple when dry, weighs forty-four pounds to a cubic foot, and when green, it is soft, full of aqueous matter, and loses, when drying, nearly one-half of its weight. In this tree, as in others which grow in wet places, the sapwood bears a large proportion to the heartwood, the latter of which consists of an irregular columnar-like in its transverse section, and occupies the central part of large trunks, with its points projecting into the sapwood. This wood has but little strength, is liable to injury from insects and ferments, and speedily decays, when exposed to the alternations of moisture and dryness. Yet it is solid, and for many purposes is preferred by workmen to other kinds of wood. It is harder than that of the white maple, and of a finer and closer grain: hence it is easily wrought in the lathe, and acquires, by polishing, a gloss;

and silky surface. It is principally employed in the manufacture of chairs, saddle-trees, shoe-last, ox-yokes, broomhandles, and various other articles of domestic use. It sometimes happens that in very old trees, the grain of the wood, instead of following a perpendicular direction, is undulated, and this variety bears the name of "curled" maple. This singular arrangement is never found in young trees, nor even in the branches of such as exhibit it in the trunk; it is also less conspicuous in the centre of the tree than near the bark. Trees offering this disposition, however, are rare. The serpentine direction of the fibres, which renders this wood difficult to split and to work, produces, in the hands of a skilful mechanic, the most beautiful effects of light and shade. These effects are rendered more striking if, after smoothing the surface of the wood with a double-ironed plane, it is rubbed with a little sulphuric acid, and afterwards with linseed oil. On examining it attentively, the varying shades are found to be owing entirely to the inflection of the rays of light; which is more sensibly perceived on viewing it in different directions by candle-light. Before mahogany became generally fashionable in the United States, the best furniture in use was made of the red-flowered maple, and bedsteads are still made of it, which, in richness of lustre, exceed those of the finest imported woods. But one of the most constant uses to which the curled maple is applied, is for the stocks of rifles and fowling-pieces, which, to elegance and lightness, unite toughness and strength, the result of the tortuous direction of the fibres. The cellular matter of the inner bark is of a dusky-red. By boiling it yields a purplish coloured liquor, which, with the addition of copperas acquires an intense dark blue or black, and is sometimes employed as ink. For this purpose, however, it is very inappropriate, as it never dries properly, and in damp weather the writing becomes glutinous, and blots. The French Canadians make sugar from the sap of this maple, which they call *plaine*, but as in the preceding species, the product of a given measure is not more than one-half as great as that of the sugar maple."—*B.*

Acer Platanoides. (Norway Maple.)

Among the maples, we should not omit speaking of the Norway maple. It is not, as its name imports, originally a native of Canada. Mr. Saunders says of it: "This is well entitled to a place in the front rank among useful and ornamental trees. It is a rapid grower, making, when well established, from one to two feet of growth each year, and in the course of ten years, under favourable circumstances, will attain a height of from twenty to twenty-five feet. The Norway maple is a very handsome tree, with a beautiful round head, clothed with long-stalked broad leaves, not deeply notched, smooth, and of fine texture, with a rich, deep, glossy green colour. This species, in common with most other European trees, is much more thickly branched than any of our native maples, and on this account furnishes a more complete shade. It is as early in leaf in spring as any of the other species of maple, and retains its foliage a week or two later in the autumn, enduring such early frosts as wither the foliage of our native species, without being materially affected, and only losing its leaves after the frosts become very severe. The bark of both the trunk and branches is neatly covered with longitudinal lines, giving it a very pretty appearance when deprived of its leaves in winter. I regard this as one of the most beautiful maples in cultivation, unsurpassed as an ornamental tree, while its perfect hardness suggests its suitability for more extended forest planting. This tree is especially valuable for the purpose of a wind-break. Evergreens, of course, are best, as affording shelter in winter. But if it be decided to plant lines of deciduous trees, the maple is one of the easiest to plant, and the most likely to continue to flourish. Its bright green foliage long remains unaffected by drought, unparched by the most fervent heat of the sun. In winter, indeed, the shelter is slight, but, in summer, long rows of maples, their foliage nearly touching, are of the greatest benefit in preventing the winds from too rapidly drying the earth—from withdrawing, in fact, too suddenly, valuable assistance bestowed on vegetation by summer showers. Of all the maples, the Norway maple is the most valuable for this purpose, for two reasons—first, it will, if permitted, branch pretty closely to the ground: secondly, it forms, more than the other maples, masses of foliage, not only at the extremity of its branches, but also within their

circling covert, and nearer to the trunk of the tree. It is, like the other maples, easily propagated, either by sowing the seed, or obtaining the young plants, self-sown, or from nurseries."

ANACARDIACEÆ.

Rhus Typhina. (Staghorn Sumach.)

New Brunswick, west through the valley of the Saint Lawrence River to southern Ontario and Minnesota, south through the northern States, and along the Alleghany Mountains to northern Georgia, central Alabama and Mississippi.

A small tree, rarely nine meters in height, with a trunk 0.15 to 0.30 meter in diameter, or often a shrub; dry hillsides, or often along streams, in sandy, moist soil. A variety with lacinate leaves occurs near Hanover, New Hampshire.

Wood, light, soft, brittle, coarse-grained, compact, satiny, susceptible of a good polish; layers of annual growth clearly marked by four to six rows of large open ducts; medullary rays numerous, obscure; colour, yellow streaked with green, the sap-wood nearly white; specific gravity, 0.4357; ash 0.50; occasionally used for inlaying cabinet work; the young shoots for "sap quills" in drawing the sap of the sugar maple.

Bark and leaves astringent, rich in tannin, and somewhat used locally as a dye, and in dressing skins; an infusion of the berries used domestically as a gargle in cases of catarrhal sore throat.

"Densely soft hairy branches and stalks. Flowers greenish-white, polygamous, forming a terminal thyryse. Fruit globular, covered with crimson hairs. Leaves pinnate, leaflets 11-31—oblong, lanceolate, serrate-pointed."—S.

LEGUMINOSÆ.

Robinia Pseudacacia. (Locust—Black Locust, Yellow Locust.)

Alleghany Mountains, Pennsylvania (Locust ridge, Monroe County) to northern Georgia; widely and generally naturalized throughout the United States, east of the Rocky Mountains, and possibly indigenous in northeastern (Crowley's ridge) and western Arkansas, and the prairies of eastern Indian Territory.

A tree twenty-two to twenty-five meters in height, with a trunk 0.90 to 1.20 meter in diameter; west of the Mississippi River much smaller, or often a low shrub 1.80 to 3 meters in height, reaching its greatest development on the western slopes of the mountains of west Virginia.

Wood heavy, exceedingly hard and strong, close-grained, compact, very durable in contact with the ground layers of annual growth, clearly marked by two or three rows of large open ducts; colour, brown, or more rarely light green, the sap-wood yellow; specific gravity, 0.7333; ash 0.51; largely used in ship-building, for posts of all sorts, construction and in turnery; preferred to other American woods for treenails, and in this form largely exported.

The bark of the root tonic, or in large doses purgative and emetic; formerly widely planted as a timber tree; its cultivation in the United States now generally abandoned on account of the destructive attacks of the locust borer. 87, 19, 312.

"Racemes slender, loose. Flowers white, fragrant. A large tree."—S.

Seeds sown in spring—transplanted at two years. Soil—any soil not too wet.

There are at least three popular varieties of the common locust, distinguishable by the colour of the heart wood, which may be described as follows:—

1. Red locust, with the heart red, and esteemed as far the most beautiful and durable timber. Posts of this variety perfectly seasoned before they are set in the ground, are estimated to last forty years, or twice as long as those of the white locust.

2. Green or yellow locust. This is the most common variety, being known by its greenish-yellow heart, and is held next best in quality to the red locust.

3. White locust, with a white heart, and is considered as the least valuable of them all.

All the above mentioned variations are supposed to be owing entirely to the soil and situations in which they grow, being caused in a similar manner as the various colours of the flowers of the hydrangea, which depend on the nature of the earth in which they are planted, and even on the colour of the water with which they are irrigated.

Gymnocladus Canadensis. (Kentucky Coffee Tree, Coffee Nut.)

Conococheague Creek, Franklin County, Pennsylvania, western New York, shores of Cayuga and Seneca Lakes, western through southern Ontario and southern Michigan to the valley of the Minnesota River, Minnesota, eastern Nebraska, eastern Kansas, southwestern Arkansas, and the Indian Territory, to about longitude 96° west, south to middle Tennessee.

A tree twenty-five to thirty-three meters in height, with a trunk 0.60 to 0.90 meters in diameter; rich woods and bottoms; not common.

Wood heavy, not hard, strong, coarse grained, durable in contact with the ground, liable to check in drying, easily worked, susceptible of a high polish; layers of annual growth clearly marked by one or two rows of open ducts; medullary rays, numerous, thin; colour, rich light brown, tinged with red, the thin sap-wood lighter; specific gravity 0.6934; ash, 0.67; occasionally used in cabinet-making, for posts, rails, etc.

The fresh leaves macerated and sweetened, are used in Tennessee as a poison for house-flies; the seeds formerly as a domestic substitute for coffee. 114, 77, 144, 200.

Readily propagated from seeds or root cuttings. A rapid growing tree on moist, rich soils.

ROSACEÆ.

Prunus Americana. (Wild Plum, Canada Plum, Horse Plum.)

Valley of the Saint Lawrence (Quebec), to the valley of Rainy and Assiniboine Rivers, and southern shores of Lake Manitoba; northern Vermont, western New England, and southward through the Atlantic States to the Chattahoochee region of western Florida, west to the valley of the upper Missouri River, Dakota and Cheyenne canon, Pike's Peak region, Colorado, southwest through Arkansas, the Indian Territory, to about longitude 102°, and the valley of the lower Concho River, Texas.

A small tree, six to twelve meters in height, with a trunk rarely exceeding 0.30 meter in diameter; rich woods, or along streams and borders of ponds and swamps, reaching its greatest development on the bottom lands of eastern Texas.

Wood heavy, very hard, strong, close grained, compact, satiny, susceptible of a beautiful polish; medullary rays numerous, thin; colour, rich bright brown, or often red, the sap-wood lighter; specific gravity, 0.7215; ash, 0.18; used for the handles of tools, etc.

Often cultivated for the yellow, red or rarely nearly black, acid or rarely sweet fruit, and furnishing an excellent stock on which to graft the varieties of the domestic plum. 97, 161, 103, 39. Sow when ripe; dry loamy soil; transplant as soon as growth warrants.

"A thorny tree, with orange or red drupes, half an inch or more in diameter; and ovate, conspicuously pointed, serrate, veiny leaves. Flowers white, appearing before the leaves in umbel-like, lateral clusters."—S.

Prunus Pennsylvanica. (Wild Red Cherry, Pin Cherry, Pigeon Cherry.)

Labrador, shores of Hudson's Bay, and west through the Saskatchewan region to the valley of the upper Fraser River, south through the northern States to Pennsylvania, central Michigan, northern Illinois, central Iowa, and along the high Alleghany Mountains of North Carolina and Tennessee, and the Rocky Mountains of Colorado.

A small tree, rarely exceeding twelve meters in height, with a trunk sometimes 0.60 meter in diameter, or in the Rocky Mountain region reduced to a low shrub; common in all the northern forests, in northern New England, taking possession of ground cleared by fire of the coniferous forests.

Wood light, soft, close-grained, compact; medullary rays numerous, thin; colour, light brown, sap-wood clear yellow; specific gravity 0.5023; ash, 0.40.

The small acid fruit used domestically, and by herbalists in the preparation of cough mixtures, etc.

"Leaves oblong, lanceolate, sharply serrate, green both sides. Flowers (appearing with the leaves) in large clusters, the pedicels elongated. Fruit globular, as large as a red currant, very sour."—*S.*

Propagated from the seed or stone. Ripe in July and should be sown immediately. Good and moderately dry soil.

"When cattle cannot reach them they spring up in numbers in woods and fence corners. Have transplanted them for shade trees. They appear hardy, thrifty and easy to transplant. The original forest here gave splendid specimens. I cut one fifty feet long to the first branch, twenty-eight inches in diameter, three feet from the ground; very curly grained; made beautiful furniture; commonly grew on light clay loam here."—*J. P. McIntyre*, Tiverton.

"Cherry very scarce here now. There were some fine trees of that beautiful wood. Have more than once split them into fence rails."—*A. Drummond*, Clifford.

"A very valuable tree, and is well adapted for this soil and climate; grows large and vigorously; some will reach a height of 120 feet, and from two and a half to three feet through at the stump. Is much sought after for lumber; brings a high price at the saw-mills; is easily raised either from the seed or by transplanting from the bush; makes excellent shade trees; grows very thick in the top, and round, much like a white ash, when isolated, and when the fruit is ripe eats very well; is one of the very hardiest trees that we have; will spring up in new growth from the stumps when cut down and will not decay early, will be the last stump in the field. Thrives best on light soil, lime on top and limestone gravel below; is to be found scattered here and there in the bush, in the Counties of Grey, Bruce, Huron, Perth, Middlesex, and Waterloo. Is good for fire-wood, timber or lumber; is also used for cabinet-making."—*R. Currie*, Wingham.

"The red or scarlet cherry is indigenous, very hardy, a great grower, with pretty sweet smelling flowers and pretty scarlet berries. It grows to a good size, and is a beautiful wood for furniture, taking a fine polish, and is very hard. It throws up quantities of suckers, and loves dry loamy land. The black cherry is also a hardy tree but not equal to the other. Its fruit grows in bunches like grapes, and makes a very good but astringent cordial. It is a handsome tree, but I don't think is used for lumber. The leaves of the scarlet cherry grow quite red in autumn, and are of great beauty."—*A. D. Ferrier*, Ferguson.

Prunus Serotina. (Wild Black Cherry, Rum Cherry.)

Southern Ontario southward through the Atlantic forests to Matanzas Inlet and Tampa Bay, Florida, west to the valley of the Missouri River, Dakota, eastern Kansas, the Indian Territory and the valley of the upper San Antonio River, Texas.

A tree eighteen to thirty meters in height, with a trunk 0.90 to 1.20 or, exceptionally, 1.50 meters in diameter; rich, generally elevated woodlands; common and reaching its greatest development on the western slopes of the Alleghany Mountains, from west Virginia southward; not common and of small size in the Gulf region and Texas.

Wood, light, hard, strong, close, straight-grained, compact, easily worked; medullary rays numerous, thin; colour, light brown or red, growing darker with exposure, the thin sap-wood yellow; specific gravity, 0.5822; ash, 0.15; largely used and esteemed in cabinet work, interior finish, etc., and now becoming scarce.

The bark contains a bitter tonic principle, and infused in cold water generates a small percentage of hydrocyanic acid, employed as a tonic and sedative in cases of pulmonary consumption, in the form of cold infusions, sirups and fluid extracts; the bitter fruit used domestically in the preparation of cherry brandy. 164, 153, 115, 61.

"Reddish brown branches. Leaves smooth, varying from oval to ovate, lanceolate, taper-pointed, serrate with short and blunt incurved teeth, shining above. Flowers in long racemes. Fruit, purplish black, edible."—*S.* Sow when ripe, shallowly; after one

season, transplant into nursery lines; dry, calcareous soil is best, but any good loam will do.

Pyrus Coronaria. (American Crab, Sweet-scented Crab.)

Ontario, valley of the Humber River, shores of Lake Erie, southward through western New York and Pennsylvania to the District of Columbia, and along the Alleghany Mountains to central Alabama and northern Mississippi, west to Minnesota, Iowa, eastern Kansas, the Indian Territory and northern Louisiana.

A small tree rarely six to nine meters in height, with a trunk often 0.30 meter in diameter; rich rather low woods, reaching its greatest development in the valleys of the lower Ohio region.

Wood, heavy, rather soft, not strong, very close-grained, checkers badly in drying; medullary rays numerous, obscure; color, brown varying to light red, the sap-wood yellow; specific gravity, 0.7048; ash, 0.52; used for levers, handles of tools, and in turnery.

Often planted for ornament on account of its fragrant blossoms; the small, yellow-green, austere fruit used for preserves, and occasionally made into cider. 109, 245, 273, 181. Does best in cool, moist places, such as the borders of woods.

“With ovate, serrate, simple leaves. Flowers in umbel-like cymes. Styles woolly and cohering at the base. Fruit a greenish apple.”—S.

Pyrus Americana. (Mountain Ash.)

Greenland, Labrador, Newfoundland, Anticosti Island, and westward along the southern shore of James' Bay to the valley of the Nelson River (White Mud Falls), southward through all mountainous regions of the northeastern States, and along the high mountains of Virginia and North Carolina, in northern Michigan, Wisconsin and Minnesota.

A small tree six to nine meters in height, with a trunk 0.30 to 0.45 meter in diameter, borders of swamps and in moist, rocky woods, reaching its greatest development on the northern shores of Lakes Huron and Superior.

Wood, light, soft, close-grained, compact; medullary rays numerous, obscure; colour, light brown, the sap-wood lighter; specific gravity, 0.5451; ash, 0.83. Often planted for ornament.

The bark and unripe fruit of the American mountain ashes are extremely astringent, and occasionally used domestically, in decoctions, infusions etc., in the treatment of diarrhoea.

“With odd pinnate leaves of 13-15 leaflets, the latter lanceolate, taper-pointed, sharply serrate, bright green. Fruit, scarlet, berry-like. Flowers in flat cymes.”—S.

Seeds sown thinly in spring, after being kept for fifteen months, transplanted the first winter. One year in nursery lines. Good sheltered soil.

Crataegus Crus-galli. (Cockspur Thorn, Newcastle Thorn.)

Valley of the Saint Lawrence River, west through southern Ontario to Manitoba, south through the Atlantic forests to the valley of the Chipola River, western Florida, and the valley of the Colorado River, Texas.

A small tree four to ten meters in height, with a trunk sometimes 0.30 meter in diameter running into various forms.

Wood, heavy, hard, not strong, close-grained, compact, satiny, susceptible of a fine polish; medullary rays numerous, very obscure; colour, brown tinged with red, the sap-wood rather lighter; specific gravity, 0.7194; ash, 0.56. The long, strong spines are occasionally collected and used to fasten sacks, and for similar purposes. 100, 240, 210, 169.

“Leaves thick, shining above, wedge-obovate, finely serrate. Petioles very short. Fruit, globular, bright red. Thorns very long.”—S.

Seeds sown in spring after being kept for fifteen months, transplanted at two years, and again at four. Soil dry, rather rich loam.

Crataegus Coccinea. (Scarlet Haw, Red Haw, White Thorn.)

West coast of Newfoundland, west along the valley of the Saint Lawrence River and the northern shores of the great lakes to Manitoba, south through the Atlantic forests to northern Florida and eastern Texas.

A small tree, sometimes nine meters in height, with a trunk 0.30 meter in diameter; open upland woods or along streams or borders of prairies; very common at the north, rare at the south; running into many forms, varying in the size and shape of the leaves, size of the fruit, etc.

Wood, heavy, hard, close-grained, compact; medullary rays thin, very obscure; colour, brown tinged with red, the sap-wood a little lighter; specific gravity, 0.8618; ash, 0.38.

"Leaves rounded, serrated. Fruit, scarlet, edible. Flowers white."—S.

Seeds treated like those of the thorn.

Crataegus Tomentosa. (Black Thorn, Pear Haw.)

New Brunswick, westward along the valley of the Saint Lawrence River and the northern shores of the great lakes to the Saskatchewan region, southward through the Atlantic forests to the Chattahoochee region of western Florida and eastern Texas, west to the mountains of eastern Washington Territory and Oregon, southwestern Colorado and southwestern New Mexico.

A small tree, six to nine meters in height, with a trunk rarely 0.45 meter in diameter or often, especially west of the Rocky Mountains, reduced to a low shrub, here forming dense thickets along mountain streams; the most widely distributed of the North American *Crataegi*, varying greatly in the size, shape and colour of the fruit, form of the leaves, amount of pubescence, etc.

Wood, heavy, hard, not strong, close-grained, compact; medullary rays numerous, thin; colour, bright reddish brown, the sap-wood lighter; specific gravity, 0.7633; ash, 0.50. 65, 213, 177, 153.

"Leaves, thickish, oval, or broadly ovate, finely serrate in marginal petioles, furrowed along the veins. Fruit, globular or pear-shaped, edible."—S.

Take, in raising thorns, the roots of three-year plants, from each of which ten or twelve cuttings can be had. Plant these in April, four inches long, projecting $\frac{1}{4}$ inch, the thick end up.

Amelanchier Canadensis. (June Berry, Shad Bush, Service Tree, May Cherry.)

Newfoundland and Labrador; west along the southern shores of Hudson's Bay to the Saskatchewan region; south through the Atlantic forests to northern Florida, southwestern Arkansas, and the Indian Territory.

A small tree, nine to fifteen meters in height, with a trunk 0.30 to 0.45 meter in diameter, or, in some forms, reduced to a low shrub; common at the north, rare at the south, and reaching its greatest development on the high slopes of the Alleghany Mountains; varying greatly in the shape of the leaves, size of the flowers, amount of pubescence on the leaves and young shoots, etc.

Wood, heavy, exceedingly hard, strong, close-grained, checking somewhat in seasoning, satiny, susceptible of a good polish; medullary rays very numerous, obscure; colour, dark-brown, often tinged with red, the sap-wood much lighter; specific gravity, 0.7838; ash, 0.55; the small fruit sweet and edible. 57, 34, 24, 19. Ripe in August; needs moist, rich ground.

"Fruit, purple, edible. Flowers, white. Leaves, serrate."—S.

HAMAMELACH.

Hamamelis Virginica. (Witch Hazel.)

Northern New England and southern Ontario to Wisconsin; south through the Atlantic region to northern Florida and eastern Texas.

A small tree, exceptionally, seven to nine meters in height, with a trunk 0.30 to 0.87 meter in diameter, or more often a tall shrub, throwing up many shoots from the ground ; common ; rich, rather damp woodlands, reaching its greatest development in the region of the southern Alleghany Mountains.

Wood, heavy, hard, very close-grained, compact ; layers of annual growth hardly distinguishable ; medullary rays numerous, thin, obscure ; colour, light-brown, tinged with red, the sap-wood nearly white ; specific gravity, 0.6856 ; ash, 0.37.

The bark and leaves rich in tannin, and largely used by herbalists in the form of fluid extracts, decoctions, etc. ; in external applications, and as a reputed remedy in hemorrhoidal affections.

"Leaves, acutely toothed. Flowers, yellow, late in autumn."—*L.*

Seeds sown as soon as obtained, as they are in ground two years before shoots appear. Soil, rich, damp woodlands.

CORNACEÆ.

Cornus Alternifolia. (Dogwood.)

New Brunswick ; west along the valley of the Saint Lawrence River to the northern shores of Lake Superior ; south through the northern States, and along the Alleghany Mountains to northern Georgia, and Alabama.

A small tree, four to eight meters in height, with a trunk 0.15 to 0.20 meter in diameter ; low, rich woods and borders of streams and swamps.

Wood, heavy, hard, close-grained, checking badly in drying ; medullary rays numerous, thin ; colour, brown, tinged with red, sap-wood light-yellow ; specific gravity, 0.6696 ; ash, 0.41.

"Leaves, mostly alternate, ovate, acute, hoary beneath. Corymbs depressed, spreading. Branches, warted. Pomes, purple, globose, about the size of a grain of pepper. Leaves, on long petioles. Branches, green or reddish-brown. Flowers, white ; May to July. Fruit, purple ; ripe in October. Decaying leaves, reddish-yellow. Naked young wood, greenish or reddish-brown."—*L.*

Mostly propagated by layers or cuttings, which, in a year or two are fit for final transplanting.

Cornus Florida. (Flowering Dogwood, Boxwood.)

Southern New England, southern Ontario, southern Minnesota, and through the Atlantic forests to latitude 28° 50' in Florida, and the valley of the Brazos River, Texas.

A small tree, nine to twelve meters in height, with a trunk 0.30 to 0.45 meter in diameter, or, towards its northern limits, reduced to a low shrub ; rich woods ; very common, especially at the South.

Wood, heavy, hard, strong, close-grained, tough, checking badly in drying, satiny, susceptible of a beautiful polish ; medullary rays numerous, conspicuous ; colour, brown, changing in different specimens to shades of green and red, the sap-wood lighter ; specific gravity, 0.8153 ; ash, 0.67 ; used in turnery, for wood engravings, and the bearings of machinery, hubs of wheels, barrel hoops, etc.

The bark, especially of the root, in common with that of the other species of the genus, possesses bitter tonic properties, and is used in decoctions, etc., in the treatment of intermittent and malarial fevers. 44, 176, 85, 69.

"Branches, shining. Leaves, ovate, acuminate, pale beneath, beset with adpressed hairs on both surfaces. Flowers umbellate, protruded after the leaves. Leaves of involucre, large, roundish, retuse, or nearly obcordate. Pomes, ovate. Flowers, greenish-yellow, and very large. Pomes, scarlet, ripe in August. Decaying leaves, yellowish-green. Naked young wood, brownish-green. Thrives best in moist peat soil, the root sheltered, the foliage exposed to the sun. By seed or layers."—*L.*

CAPRIFOLIACEÆ.

Viburnum Lentago. (Sheepberry, Nannyberry.)

Southern shores of Hudson Bay ; west in British America to about longitude 102° ; south through the northern States to southern Indiana and St. Louis County ; Missouri and along the Alleghany Mountains to northern Georgia.

A small tree, six to nine meters in height, with a trunk sometimes 0.15 to 0.20 in diameter; rocky ridges and along borders of streams and swamps, in rich, moist soil; most common and reaching its greatest development far north.

Wood, heavy, hard, close-grained, emitting a disagreeable odor; medullary rays thin, barely distinguishable; colour, dark, orange-brown, the sap-wood nearly white; specific gravity, 0.7303; ash, 0.29.

"A small tree, with ovate, finely serrate, pointed leaves, with long and margined petioles. Fruit, black."—*S.*

Seeds sown late in fall, transplanted at two years.

ERICACEÆ.

Kalmia latifolia. (Laurel, Calico Bush, Spoon Wood, Ivy.)

New Brunswick and the northern shores of Lake Erie, south to western Florida, and through the Gulf States to western Louisiana, and the valley of the Red River, Arkansas.

A small tree sometimes 9 to 12 meters in height, with a trunk 0.30 to 0.60 meter in diameter, or more often a low shrub; rich woodlands; most common and reaching its greatest development in the southern Alleghany Mountains, here often forming dense impenetrable thickets.

Wood heavy, hard, strong, close-grained, brittle, compact; principal medullary rays broad, dark brown, conspicuous; intermediate rays numerous, thin, inconspicuous; colour, brown tinged with red, the sap-wood somewhat lighter; specific gravity, 0.7160; ash, 0.41; used for tool handles in turnery and for fuel.

The leaves, buds, and fruit, reputed poisonous to cattle, are occasionally used medicinally. 101, 258, 219, 168.

"Leaves on long petioles, scattered, or three in a whorl, oval, coriaceous, smooth and green on both surfaces, corymbs terminal, downy and viscid. Flowers white, tinted with pale-pink, delicately spotted; June and July."—*L.* Sow in autumn; transplant in a year. Soft, loose, cool soil, northern exposure.

Rhododendron Maximum. (Great Laurel, Rose Bay.)

Nova Scotia and the northern shores of Lake Erie, south through New England, New York, and along the Alleghany Mountains to northern Georgia.

A small tree sometimes ten to twelve meters in height, with a trunk rarely exceeding 0.30 meter in diameter, or often a tall, straggling shrub; at the north, in cold swamps; rare; very common and reaching its greatest development in the southern Alleghany Mountains, steep, rocky banks of streams, etc.; never on limestone.

Wood, heavy, hard, strong, close-grained, compact; medullary rays numerous, thin; colour, light clear brown, the sap-wood lighter; specific gravity, 0.6303; ash, 0.36; occasionally used in turnery for the handles of tools, etc., and a possible substitute for box-wood in engraving. A decoction of the leaves is occasionally used domestically in the treatment of rheumatism, sciatica, etc. 148, 242, 205, 156.

"Arborescent, leaves elliptic—oblong, acute, convex, bluntish at the base, whitish or rusty beneath, glabrous; flowers, pale red, in umbellate corymbs, studded with green, yellow, or purple protuberances; June to August; capsules brown; ripe in September."—*L.* Grow as last.

OLEACEÆ.

Fraxinus Americana. (White Ash.)

Nova Scotia, New Brunswick, southern Ontario, to northern Minnesota, south to northern Florida, central Alabama and Mississippi, and west to eastern Nebraska, eastern Kansas, the Indian Territory, and the Valley of the Trinity River, Texas.

A large tree of the first economic value, fifteen to thirty or, exceptionally, forty-two meters in height, with a trunk 1.20 to 1.80 meter in diameter; low, rich, rather moist

soil, reaching its greatest development in the bottom lands of the lower Ohio River basin; towards its western and southwestern limits smaller, of less economic value, and generally replaced by the green ash.

Wood heavy, hard, strong, ultimately brittle, coarse-grained, compact; layers of annual growth clearly marked by several rows of large open ducts, occupying in slowly grown specimens nearly the entire width of the annual rings; medullary rays numerous, obscure; colour, brown, the sap-wood much lighter, often nearly white; specific gravity, 0.6543; ash, 0.42; specific gravity of the heavier sap-wood, 0.7180; largely used in the manufacture of agricultural implements, carriages, handles, oars, and for interior and cabinet work. 130, 91, 106, 121.

Fruit winged from the apex only, cylindrical; branchlets and petioles smooth and glabrous; calyx very minute, persistent; leaflets, 7-9 stacked.

"Seeds kept in dry earth eighteen months, sown in March, transplanted at first year, and again two years after. Strong loamy soil. Thrives best on land that is not too heavy, and is inclined to be a little wet. Often springs up in fence corners and is not injured by the severity of winter; is a little hard to transplant from the bush, owing to the nature of its roots, as they spread widely and are not fibrous near the trunk. Think, as the tree grows rapidly, sowing and transplanting might be the best."—*D. Marshall, Alvanley.*

"Requires low, clay, flat land: they and the soft elm grow together in the bush."—*John O'Callahan, North Gower.*

"This valuable forest tree is now rapidly disappearing throughout this section of country, and I have often thought a substitute for it will be difficult to find. This tree delights in a moist, rich clay or alluvial soil with a clay subsoil, it is a rapid grower when properly treated, which treatment consists in giving it sufficient space to rear its head from among the surrounding undergrowth and carefully preserving its top from browsing or other injury. I do not find it inclined to grow from its own seed, as young seedlings are not easily obtained, it is much inclined to sprout from the stump, these sprouts generally throw out above ground if the stump is green, otherwise it will sprout from the green surface roots, and with care many young shoots can be obtained, having some rootlets attached, and this perhaps is the readiest way of obtaining young plants for transplanting. I think we have no timber growing in our forests, that can be fairly considered its equal for many purposes, its strength, lightness, swiftness and elasticity, render it superior to all other native woods for waggon and sleigh tongues, reaper and mower tongues, fork, spade, shovel, and hoe handles, neckyokes, etc., etc., also for cabinet purposes. It is, in my opinion, one of the most valuable of all our native trees, and ought to be carefully preserved and its growth encouraged in all suitable situation. If capitalists would turn their attention to the growth of this timber, I have no doubt they would realize a handsome profit on the outlay, and confer a great benefit on posterity."—*Thomas Harris, Meaford.*

"The white ash is a very easy tree to cultivate or transplant. Five or six years ago I transplanted from my forest a variety of young trees, among them a few ash, every one of which grew."—*Samuel MacColl, Cowal.*

"The tree grows sparingly in this locality. Its seedlings do not spring up readily in the forest or surrounding fields. The few that do get a start, make fair growth if well protected when young, where the soil is good. That most suitable to the ash is a rich clay loam. Some seedlings that I have measured on good soil, made a growth ranging from 6 inches to 2 feet 6 inches annually, and I have found some of five years measuring 10 feet in height. I do not think the tree is partial to situation, growing either exposed to the sun or in the shade. As to transplanting from forest or beds, I cannot say much, very few having been so planted within my view."—*N. A. Malloy, Laskay.*

"The white ash, if planted in rows about three feet apart and two feet between trees, in a cool and damp, but not wet soil, the alternate trees will, at the end of ten years, afford the best of hoop-poles, and afterwards, at intervals of ten or fifteen years, other thinings of much greater value. As an ornamental tree, it thrives finely in full exposure, but the shade is not dense. Grows in moist woods, from Canada to Florida."—*Hough.*

"The wood of the white ash, in young, thrifty trees, is very white from the bark to the centre; but in large old trees, the heart wood is of a reddish tinge, and the sap-wood white. When the annual layers are thick and coarse it is exceedingly tough and elastic, and may be applied to all the various purposes for which the *fraxinus excelsior* is used in Europe. In America the wood of this tree is highly esteemed for its strength and suppleness, and is advantageously employed for a great variety of uses, of which we shall mention only a few of the most common. It is selected by coach and waggon-makers for felloes of wheels, for shafts, and for the frames of carriage bodies, and for those of light waggons. It is also in very general use for agricultural implements and domestic wares, particularly for the handles of spades, hoes, shovels, forks, rakes, scythes, etc. In Canada, and the northern parts of the United States, it is extensively used for hoops and staves, the latter of which are of a quality between those of the white and red oaks, and are esteemed best for casks containing salted provisions and flour. It has also been admitted into the lower frames of vessels, but is considered inferior to that of the yellow birch (*betula excelsa*), and to the heart of the red birch. For the blocks to pulleys, particularly those used in ships, and the pins for belaying the cordage, this wood is very appropriate; and on account of its strength and elasticity it is esteemed as superior to every other species of timber for oars. It is extensively exported to Europe, especially to England, in the form of planks, and the oars of this wood are used in all the navies of the world. The inner bark of this tree imparts a very permanent yellow to skins, and may be used with advantage in dyeing wool."—*Browne*.

The species is always propagated by seeds, and the varieties by grafting or budding on the species. The seeds should be gathered as soon as they are ripe, and taken to the rotting-ground, where they should be mixed with light sandy earth, and laid in a flat heap not more than ten inches thick, in order to prevent them from heating. Here they should be turned over several times in the course of the winter; and as early as the ground will permit in the spring, they may be removed, freed from the sand by sifting, and sown in beds in a middling soil. The richness or quality of the soil, Lang observes, is of little consequence, but it should be well broken by the rake, and the situation should be open to prevent the plants from being drawn up too slender. The seeds may be deposited at the distance of half an inch every way, and covered about a quarter of an inch deep with soil. The plants may be taken up at the end of the first season, and planted in nursery lines; and at the end of the second year, they may be removed to where they are finally to remain. All these ashes grow well in a rich clay soil, rather moist than dry; the black ash loves the swamp.

Fraxinus pubescens. (Red Ash.)

New Brunswick to southern Ontario and northern Minnesota, south to northern Florida and central Alabama.

Wood, heavy, hard, strong, brittle, coarse-grained, compact; medullary rays, numerous, thin; colour, rich brown, the sap-wood light brown, streaked with yellow; specific gravity, 0.6251; ash, 0.26; specific gravity of the lighter sap-wood, 0.5609; somewhat used as a substitute for the more valuable white ash, with which it is often confounded. 151, 182, 101, 162.

Red ash has the branchlets softly pubescent, and the fruit acute at the base, two-edged, and gradually expanding into the long wing above.

Fraxinus viridis. (Green Ash.)

Shores of Lake Champlain, Tiverton, Rhode Island, and southward to northern Florida, west to the valley of the Saskatchewan, the eastern ranges of the Rocky Mountains of Montana, the Wahsatch Mountains of Utah, and the ranges of eastern and northern Arizona.

A tree fifteen to eighteen meters in height, with a trunk rarely exceeding 0.60 meter in diameter; borders of streams, or in low rather moist soil; at the west confined to the bottom lands of the large streams, and to high mountain canons.

Wood, heavy, hard, strong, brittle, rather coarse-grained, compact, satiny, containing numerous scattered small open ducts ; the layers of annual growth marked by several rows of larger ducts ; medullary rays, numerous, obscure, colour brown, the sap-wood lighter ; specific gravity, 0.7117 ; ash, 0.65 ; inferior in quality, although often used as a substitute for white ash. 105, 133, 91, 114.

The green ash is easily recognized by the brilliant colour of its young shoots, and by its leaves being nearly of the same colour on both surfaces.

Fraxinus sambucifolia. (Black Ash, Hoop Ash, Ground Ash.)

Southern Newfoundland, along the northern shores of the Gulf of St. Lawrence, south-westerly to the eastern shores of Lake Winnipeg, south through the northern States to Newcastle County, Delaware, the mountains of Virginia, southern Illinois, and northwestern Arkansas.

A tree twenty-five to thirty meters in height, with a trunk 0.30 to 0.60 meter in diameter ; swamps and low river banks ; the most northern representative of the genus in America.

Wood, heavy, soft, not strong, tough, rather coarse-grained, compact, durable, separating easily into thin layers ; layers of annual growth, strongly marked by several rows of large open ducts ; medullary rays, numerous, thin ; colour, dark brown, the sap-wood light brown, or often nearly white ; specific gravity, 0.6318 ; ash, 0.72 ; specific gravity of the heavier sap-wood, 0.7465 ; largely used for interior finish, fencing, barrel-hoops, in cabinet-making, and the manufacture of baskets. 149, 142, 125, 175.

"The buds are of a deep blue, and the young shoots are sprinkled with dots of the same colour, which disappear as the season advances. The leaves, at their unfolding, are accompanied with scales, which fall after two or three weeks ; they are twelve to fifteen inches long when fully developed ; and the leaflets are sessile, of a deep green colour, smooth on the upper surface, and coated with red down on the main ribs beneath. When bruised they emit an odour like that of the leaves of the elder. The samaras resemble those of the blue ash, and are nearly as broad at the base as at the summit. The black ash is easily distinguishable from the white ash by its bark, which is of a duller hue, less deeply furrowed, and has the layers of the epidermis applied in broad sheets."—*L.*

LAURACEÆ.

Sassafras officinale. (Sassafras.)

Eastern Massachusetts, southwestern Vermont, and west through southern Ontario and central Michigan to southeastern Iowa, eastern Kansas, and the Indian Territory ; south to Hernando County, Florida, and the valley of the Brazos, Texas.

A tree, twelve to fifteen meters in height, with a trunk 0.60 to 0.90 meter in diameter, or towards its northern limits reduced to a small tree or shrub ; rich, sandy loam, reaching its greatest development in southwestern Arkansas and the Indian Territory ; at the south often taking possession, with the persimmon of abandoned fields in the middle districts.

Wood, light, soft, not strong, brittle, coarse-grained, very durable in contact with the soil, slightly aromatic, checking in drying ; layers of the annual growth clearly marked with three or four rows of large open ducts ; medullary rays numerous, thin ; colour, dull, orange brown, the thin sap-wood light yellow ; specific gravity 0.5042 ; ash, 0.10 ; used for light skiffs, ox-yokes, etc., and largely for fence posts and rails, and in cooperage.

The root, and especially its bark, enters into commerce, affording a powerful aromatic stimulant ; the oil of sassafras, distilled from the roots, is largely used in imparting a pleasant flavour to many articles of domestic use ; the pith of the young branches infused with water, furnishes a mucilage used as a demulcent in febrile and inflammatory affections, 202, 273, 235, 221.

"Yellowish or greenish yellow twigs and ovate, or three-lobed entire leaves. Flowers greenish yellow in naked corymbs, appearing with the leaves in the axils of the latter.

Drupe blue, on a reddish pedicel. The nine stamens in three rows, the three inner, each with a pair of yellow glands at the base of the filament."—S.

The laurus sassafras will grow in any free soil, rather moist than dry, and is generally propagated from seeds, which should be sown or put into a rot-heap as soon as received, as they remain a year, and sometimes two or three years in the ground before they vegetate. The sassafras may also be propagated by cuttings of the roots, or by suckers thrown up by old trees. The situation where the trees is to be finally planted, should be sheltered; and, in the northern parts of Britain, as well as in Canada, in order to insure fine foliage, it should be planted against a wall.

Medicinally, the wood, bark, and roots of the sassafras, are considered to be an excellent stimulant and sudorific, and may be advantageously employed in materia medica, and in the veterinary art. They were formerly much celebrated in the cure of various complaints, particularly in rheumatism, dropsy, and cutaneous eruptions; but, by modern practitioners, they are only recognized as forming a warm stimulant and diaphoretic. The wood is slightly aromatic, and slightly acrimonious, depending on a resin and an essential oil; but the smell and taste which are peculiar to this vegetable, are more sensible in the young branches, and comparatively more so in the bark of the roots. A decoction of the sassafras chips, sold by druggists, is well known as a remedy for scorbutic affections.

The bark and pith of the young twigs, as well as the tender leaves, abound with a pure mucilaginous principle, resembling that of the *Hibiscus esculentus*. Mucilage of sassafras pith is peculiarly mild and lubricatory, and has been used with much benefit in dysentery and catarrh, and particularly as a lotion in the inflammatory stages of ophthalmia. From the bark of the roots the greatest quantity of essential oil is extracted, which, after long exposure to the cold, it is said, deposits very beautiful crystals. The flowers of this tree, which have a weak, aromatic odour when fresh, are considered stomachic and efficacious in purifying the blood; and for this purpose, during a fortnight in the spring, an infusion of them is drunk with a little sugar, in the manner of tea. In Louisiana, the leaves are used to thicken pottage; and in various parts of the United States, an agreeable beverage is formed with the aid of the young shoots and of the bark of the roots, usually known by the name of "Root Beer," which is considered as very salutary during the months of the summer. The fruits of the sassafras are much in quest by perfumers, who convert them into powders, which they put up in small sachets; but what are known by druggists under the name of "sassafras nuts," are the fruit of the *Laurus puckeri*, a native of Peru.

URTICACEÆ.

Ulmus fulva. (Red Elm, Slippery Elm, Moose Elm.)

Valley of the lower Saint Lawrence River to Ontario and northern Dakota, south to the Chattahoochee region of northern Florida, central Alabama and Mississippi, and the valley of the San Antonio River, Texas.

A tree thirteen to twenty meters in height, with a trunk 0.45 to 0.60 meter in diameter; borders of streams and hillsides, in rich soil.

Wood, heavy, hard, strong, very close-grained, compact, durable in contact with the ground, splitting readily when green; layers of annual growth clearly marked by several rows of large, open ducts; medullary rays, numerous, thin; colour, dark brown, or red, the thin sap-wood lighter; specific gravity, 0.6956; ash, 0.83; largely used for wheel stock, fence posts, rails, railway ties, sills, etc.

The inner bark mucilaginous, nutritious, and extensively used in various medicinal preparations. 111, 110, 101, 66.

"Buds in spring soft and downy, with large rusty hairs; branches also somewhat downy. Leaves, thick, ovate, oblong, taper-pointed, very rough above, velvety beneath, often six to eight inches long."—F.

Seed sown in fall, transplanted the following summer, ready for forest ground in two years. Soil, light loam.

Ulmus racemosa. (Rock Elm, Cork Elm, Hickory Elm, White Elm, Cliff Elm.)

Southwestern Vermont, west through western New York, Ontario, and southern Michigan to northeastern Iowa, and south through Ohio to central Kentucky.

A large tree, of great economic value, twenty to thirty meters in height, with a trunk sometimes 0.90 meter in diameter; low, wet clay, rich uplands, rocky declivities, or river cliffs; common and reaching its greatest development in southern Ontario and the southern peninsula of Michigan.

Wood, heavy, hard, very strong, tough, very close-grained, compact; susceptible of a beautiful polish; layers of annual growth marked with one to two rows of small, open ducts; medullary rays, numerous, obscure; colour, light, clear brown, often tinged with red, the thick sap-wood much lighter; specific gravity, 0.7263; ash, 0.60; largely used in the manufacture of heavy agricultural implements, wheel stock, and for railway ties, bridge timbers, sills, etc. 93, 62, 36, 38.

"Twigs and bud scales downy, and branches often with corky ridges. Leaves, ovate, oblong, oblique at the base, sharply serrate. Flowers in racemes and not in compact or close clusters, as in our other native species. Fruit, smooth, oval or elliptic; very downy with the margins thickly fringed."—*F.*

"It takes more kindly to civilization than any other tree, as far as my observation has obtained. It springs up in fence corners, and in a very few years it forms a graceful and beautiful tree. The elm thrives best on rich, flat land, or on strong clay soil."—*James Halls*, Elmsville.

"Elm grows fast here, soon becomes a shade for cattle, and is a useful timber."—*D. Spence*, Whittington.

Seed ripe in June; if sown at once will make good shoots the first season; transplant while small.

Ulmus Americana. (White Elm, American Elm, Water Elm.)

Southern Newfoundland to the northern shores of Lake Superior and the eastern slope of the Rocky Mountains, in about latitude 52° N., south to Cape Canaveral and Pease Creek, Florida, extending west in the United States to the Black Hills of Dakota, central Nebraska, the Indian Territory in about longitude 100° W., and the valley of the Rio Concho, Texas.

A large tree, thirty to thirty-five meters in height, with a trunk 1.80 to 2.70 meters in diameter; rich, moist soil, borders of streams, etc.; towards its western and southwestern limits only in river bottoms.

Wood, heavy, hard, strong, tough, rather coarse-grained, compact, difficult to split; layers of annual growth clearly marked by several rows of large open ducts; medullary rays numerous, thin; colour, light brown, the sap-wood somewhat lighter; specific gravity, 0.6506; ash, 0.80; largely used for wheel-stock, saddle-trees, flooring, in cooperage, and now largely exported to Great Britain and used in boat and ship building. 136, 205, 110, 146.

"Small branches and twigs smooth. Leaves, three to four inches long, thin ovate, oblong or oval, abruptly pointed, sharply serrate, rather velvety and soft beneath. Flowers in close clusters or bundles. Fruit, smooth except on the margin."—*F.* Sow when ripe; transplant in a year.

"The elm attains a diameter of six inches in ten years in this part of the country (I mean what people call "swamp" elm), and if attended to, the limbs cut from the trunk, etc., so as to give the main stem a shape, it will grow to be quite useful for many purposes in twenty years. Does well in any soil."—*James Lane*, Denbigh.

Celtis Occidentalis. (Sugarberry, Hackberry.)

Valley of the Saint Lawrence River, west to eastern Dakota, south through the Atlantic region to Bay Biscayne and Cape Romano, Florida, and the valley of the Devil's River Texas.

A large tree, eighteen to thirty, or exceptionally thirty-six to thirty-nine meters in height, with a trunk 0.60 to 1.50 meter in diameter; most common and reaching its greatest development in the Mississippi River basin; rich bottoms or dry hillsides; sometimes reduced to a low shrub, and varying in the size, shape and texture of the leaves; the extremes connected by innumerable intermediate forms, which, thus considered, make one polymorphous species of wide geographical range.

Wood, heavy, rather soft, not strong, coarse-grained, compact, satiny, susceptible of a good polish; layers of annual growth clearly marked by several rows of large open ducts, containing many small groups of smaller ducts arranged in intermediate concentric rings; medullary rays, numerous, thin; colour, clear light yellow, the sap-wood lighter; specific gravity, 0.7287; ash, 1.09; largely used for fencing and occasionally in the manufacture of cheap furniture. 98, 143, 127, 160.

"Young leaves and twigs silky; leaves two inches long; long, ovate, pointed, sharply serrate, abruptly contracted at base. Fruit, dark purple, with sweet pulp, greedily eaten by several species of birds."—*F.* Layers or seeds; rich, moist soil.

Morus Rubra. (Red Mulberry.)

Western New England and Long Island, New York, west through southern Ontario and central Michigan to the Black Hills of Dakota, eastern Nebraska and Kansas, south to Bay Biscayne and Cape Romano, Florida, and the valley of the Colorado River, Texas.

A large tree, eighteen to twenty meters in height, with a trunk 0.90 to 1.20 meter, or exceptionally 2.15 meters in diameter; generally in rich bottom lands; most common and reaching its greatest development in the basins of the lower Ohio and Mississippi Rivers.

Wood, light, soft, not strong, rather tough, coarse-grained, compact, very durable in contact with the soil, satiny, susceptible of a good polish; layers of annual growth clearly marked by several rows of large open ducts; medullary rays, numerous, thin; colour, light orange yellow, the sap-wood lighter; specific gravity 0.5898; ash, 0.71; largely used in fencing cooperage, for snaths, and at the south, in ship and boat-building.

The large, dark purple fruit, sweet and edible. 163, 173, 141, 179.

"Leaves, broad, heart-shaped, serrate and rough above, and downy underneath. On young shoots the leaves are variously lobed. Fruit, dark red, turning to purple when fully ripe."—*F.* Sow in spring; transplant in a year; cover the young plants the first winter.

PLATANACEÆ.

Platanus Occidentalis. (Sycamore, Button Wood, Button Ball Tree, Water Beech.)

Southern Main and southeastern New Hampshire to northern Vermont and the northern shores of Lakes Ontario and Erie, west to eastern Nebraska and Kansas, south to northern Florida, central Alabama and Mississippi, and the valley of Nueces River, Texas, extending southeast to the valley of the Devil's River.

The largest tree of the Atlantic forests, often thirty to forty meters in height, with a trunk 2.40 to 4.20 meters in diameter; generally along streams and river bottoms, in rich, moist soils; very common and reaching its greatest development in the bottom lands of the Ohio and Mississippi Rivers; the large specimens generally hollow.

Wood, heavy, hard, not strong, very close-grained, compact, difficult to split and work; layers of annual growth clearly marked by broad bands of small ducts; the numerous medullary rays very conspicuous, as in that of all the North American species; colour brown tinged with red, the sap-wood lighter; specific gravity, 0.5678; ash, 0.46; largely used for tobacco boxes (its principal use) ox-yokes, butchers' blocks, and rarely in the manufacture of cheap furniture. 173, 146, 222, 144.

"Leaves, large six to ten inches broad, roundish, heart-shaped, but deeply and angularly lobed and toothed, covered when young with dense whitish down, but soon becoming smooth. The pendulous fruit about an inch in diameter."—*F.* Moist, free soil, or clo to water; sow lightly in autumn; protect with litter; transplant when large enough.

JUGLANDACEÆ.

Juglans Cinerea. (Butternut, White Walnut.)

Southern New Brunswick, Valley of the Saint Lawrence River, Ontario and southern Michigan to northern Minnesota and central Iowa, south to Delaware and along the Alleghany Mountains to northern Georgia, central Alabama and Mississippi, northern Arkansas and southeastern Kansas.

A tree eighteen to twenty-four, or exceptionally thirty to thirty-five meters in height, with a trunk 0.60 to 0.90 meter in diameter; rich woodlands; rare at the south, most common and reaching its greatest development in the Ohio River basin.

Wood, light, soft, not strong, rather coarse-grained, compact, easily worked, satiny, susceptible of a beautiful polish, containing numerous, regularly distributed, large, open ducts medullary rays distant, thin, obscure; colour, bright, light brown, turning dark with exposure, the sap-wood lighter; specific gravity, 0.4086; ash 0.51; largely used for interior finish, cabinet work, etc.

The inner bark, especially that of the root, is employed medicinally, as a mild cathartic, and furnishes a yellow dye. 270, 181, 238, 205.

"Leaflets, oblong, lanceolate, pointed, rounded at the base, downy, especially underneath, and petioles and branches with clammy hairs. Fruit, oblong, clammy, and the nut deeply sculptured and with ragged sharp ridges; kernel sweet, rich and oily. A well known tree, with gray bark and only slightly furrowed on the stems of old trees."—*F.*

"This tree, when grown alone, is noted for its broad, spreading habit, but in woods, among other trees, it grows to forty or sixty feet in height. Its lumber is brownish-white, and in texture much like that of the black walnut. It works smoothly, takes a good finish, and is much used for inside finishings. This tree is widely distributed throughout the northern and middle states, is easily raised from the nuts, and, like the black walnut, it is difficult to transplant. It prefers a rich calcareous soil, and under favourable circumstances, its growth is quite rapid. It must, however, be crowded laterally, if we wish to have it form a straight trunk. The bark of the butternut has medicinal qualities that give it the specific name—*Cathartica*, as applied by Michaux. It is also sometimes used for dyeing, and it possesses some tanning properties."—*Hough*.—Plant as Walnut.

Juglans nigra (Black Walnut.)

Western Massachusetts, west along the southern shores of Lake Erie, through southern Michigan to southern Minnesota, eastern Nebraska, and eastern Kansas, south to the Chattahoochee region of northern Florida, central Alabama and Mississippi, and the valley of the San Antonio River, Texas.

A large tree, often thirty to forty-five meters in height, with a trunk 0.80 to 3 meters in diameter, rich bottom lands and hillsides, most common, and reaching its greatest development on the western slopes of the southern Alleghany Mountains, and now everywhere scarce.

Wood, heavy, hard, strong, rather coarse-grained, liable to check if not carefully seasoned, easily worked, susceptible of a beautiful polish, durable in contact with the soil, containing numerous large, regularly-distributed open ducts; medullary rays, numerous, thin, not conspicuous; colour, rich dark brown, thin sap-wood much lighter; specific gravity, 0.6115; ash, 0.79; more generally used in cabinet-making, interior finish and for gun stocks than that of any other North American tree. 165, 63, 109, 46.

"Leaflets eleven to twenty-one, ovate-lanceolate, slightly pubescent beneath, pointed, slightly heart-shaped at base, neither leaves, stalks or fruit clammy, as in the last. Fruit large, round, somewhat dotted, but not furrowed. Shell of nut black, or dark brown, very rough, kernel large, very oily, and a strong, rather disagreeable flavour, but not at all poisonous as sometimes stated."—*F.*

Seeds gathered in fall, mixed with sand, and left in heaps exposed to frosts, planted in spring, transplanted at one or two years. Soil deep, strong loam.

"I notice that they do better on clay loam. We have one tree on clay loam and five or six on lighter land with a gravel bottom. The one tree is doing far best both in growth and production. My trees were planted about twelve years, (that is, the nuts, I mean), and the trunks are now from five to eight inches through. The nuts should be planted in November, about one and a half or two inches deep, so that the frost will crack the shell ready for the coming spring. I think it would be well for any person having land, to plant a few acres, as the timber will be very valuable, besides the nuts are very saleable."—*George L. Shipley, Falkirk.*

"The black walnut grows in a very satisfactory manner, if it is allowed to grow in woods, or in fields adjacent to the woods. I had two, which were raised from the seed in the garden; these were taken up when young and planted out in my lane; they did very well, but finding one too near an apple tree, I removed it to another place, after the lapse of three years or so, and, although I took every care in transplanting it, it was years before it made much, or I may say any growth, and has never made satisfactory growth. The walnut requires a very rich soil, and in its natural state the soil is very suitable for the growth of a kind of rush. I formerly had large walnut trees growing on my place."—*E. B. Harrison, Ridgetown.*

"Black walnut trees left when clearing have grown little in forty years, but those from seed have made good progress."—*T. Beekton, Glencoe.*

"When the wood of this tree has a waved or curly grain, it is highly prized for veneers. Such pieces are best obtained from a crotch of large limbs, or from the stumps or large roots, or, better still, from the large burls or excrescences that are sometimes found on the trunk. Enormous prices have been paid for single trees having an exceptionally fine grain. This may be justly regarded as among the most valuable of our native species, and in a rich and rather humid soil is among the most profitable to plant. It will grow very well, but not so rapidly, upon lands that are dry, and in a climate approaching the arid, and it is found well adapted for cultivation upon the prairies and the eastern borders of the great plains. As it sends down a strong tap-root, and is very liable to suffer in transplanting, it should always be planted where it is to remain. This may be done in autumn or early in the spring, and if the latter, from nuts that have been exposed to freezing. Lay the nuts out of doors, under some litter, for the winter, to freeze."—*Hough.*

Carya alba. (Shell-bark Hickory. Shag-bark Hickory.)

Valley of the Saint Lawrence River, along the northern shores of Lakes Ontario and Erie to southern Michigan and southeastern Minnesota, south to the Chattahoochee region of western Florida, central Alabama and Mississippi, and west to eastern Kansas the Indian Territory, and eastern Texas.

A large tree of the first economic value, twenty-four to thirty, or, exceptionally, thirty-nine to forty-five meters in height, with a trunk 0.90 to 1.20 meter in diameter; rich hillsides and sandy ridges; common, and reaching its greatest development west of the Alleghany Mountains; varying greatly in the size and the shape of the fruit. A form with small, thin shelled nuts is not rare from Delaware southward and in Michigan.

Wood, heavy, very hard and strong, tough, close-grained, compact, flexible; layers of annual growth clearly marked by one to three rows of large open ducts; medullary rays, numerous, thin; colour, light brown, the thin and more valuable sap-wood nearly white; specific gravity, 0.8372; ash, 0.73; largely used in the manufacture of agricultural implements, carriages, axe handles, baskets, etc.

The sweet and edible nuts form an important article of commerce. 36, 12, 11, 27.

"Leaflets, in a leaf, 5-7; oblong-acuminate, argutely serrate; villous beneath; the pair nearest to the base of the petiole rather remote from it; terminal leaflet nearly sessile. Catkin glabrous. Fruit depressedly globose, with four longitudinal furrows, in the lines of which the husk divides into four valves that become wholly separate. Nut, compressed, oblique, four-angled in its transverse outline, white. Bark exfoliating in long narrow strips."—*L.*

Seeds prepared as for black walnut—planted in sand in spring—transplanted at one or two years. Good fertile forest soil.

Carya Tomentosa. (Mocker Nut, Black Hickory, Bull Nut, Big-bud Hickory, White-heart Hickory, King Nut.)

Valley of the Saint Lawrence River, northern shores of Lakes Ontario and Erie to eastern Nebraska, eastern Kansas and the Indian Territory, south to Cape Canaveral and Tampa Bay, Florida, and the valley of the Brazos, Texas.

A tree twenty-four to thirty or, exceptionally thirty-three meters in height, with a trunk 0.90 to 1.20 meter in diameter, generally on rich upland hillsides—less commonly in low river bottom lands, very common in the Gulf States, and throughout the south, the most widely distributed species of the genus.

Wood, heavy, very hard, strong, tough, very close-grained, checking in drying, flexible, containing few large, regularly-distributed open ducts; medullary rays, numerous, thin, obscure; colour, dark rich brown, the thick sap-wood nearly white; specific gravity, 0.8216; ash, 1.06; used for the same purposes as that of the shell-bark hickory. 43, 42, 26, 36.

"Petiole, downy beneath. Leaflets in a leaf 7-9; obovate-lanceolate, serrate with shallow teeth; downy and rough beneath; lateral ones sessile. Catkins very tomentose. Fruit, on some trees, globose, with depressions in the husk at the sutures."—*L.* Plant as above.

Carya Porcina. (Pig Nut, Brown Hickory, Black Hickory, Switch-bud Hickory.)

Southern Maine to southern Ontario, southern Michigan and Minnesota, eastern Nebraska, eastern Kansas, and the Indian Territory, south to Cape Canaveral and Pease Creek, Florida, and the valley of the Nueces River, Texas.

A tree twenty-four to thirty, or, exceptionally, forty meters in height, with a trunk 0.90 to 1.20 meter in diameter; dry hills and uplands; common.

Wood, heavy, hard, very strong and tough, flexible, close-grained, checking in drying, containing many large open ducts; colour, dark or light brown, the thick sap-wood lighter, often nearly white; specific gravity, 0.8217; ash, 0.99; used for the same purposes as that of the shell-bark hickory. 42, 92, 31, 43.

Leaflets 5-7 in a leaf, ovate acuminate, serrate, glabrous, dotted beneath with dots of resinous matter; terminal leaflet sessile. Nut obcordate. Fruit round, somewhat rough. Flowers greenish; May; fruit with a greenish husk, enclosing a brownish nut; ripe in November.

Seeds prepared and treated same as hickory.

Carya Amara. (Bitter Nut, Swamp Hickory.)

Southern Maine to the Valley of the Saint Lawrence River, west through Ontario, central Michigan, Minnesota to eastern Nebraska, eastern Kansas, and the Indian Territory south to the Chattahoochee region of western Florida and the valley of the Trinity River, Texas.

A tree eighteen to twenty-four meters in height, with a trunk 0.60 to 0.90 meter in diameter; borders of swamps and streams, in low ground or often on dry rich uplands.

Wood, heavy, very hard, strong, tough, close-grained, checking in drying; layers of annual growth marked by several rows of large open ducts; medullary rays, numerous, obscure; colour, dark brown, the thick sap-wood light brown, or often nearly white; specific gravity, 0.7552; ash, 1.03; largely used for hoops, ox-yokes, etc. 71, 86, 30, 78.

"Leaflets in a leaf, 7-9; ovate oblong, acuminate, serrate with deep teeth, glabrous; lateral ones sessile; sets of catkins in pairs. Fruit, roundish-ovate, bearing in its upper half four wing-like ridges; husk, thin and fleshy, softening and decaying, and never becoming ligneous, as in the other species. Flowers, greenish; April. Fruit, with a greenish husk, enclosing a white nut; ripe in October."—*L.* Plant as before. In trans-

planting, the difficulty in all walnuts and hickories is the long tap root. When any size, a tap root has small roots at the bottom ; if all can be moved and planted growth will proceed ; but if not the tap root is best cut off. Some say best in any case. But to sow where the tree is to remain always answers.

MYRICACEÆ.

Myrica Cerifera. (Bayberry, Wax Myrtle.)

Shores of Lake Erie; Maine, and south near the coast to Florida Keys and southern Alabama.

A tree, sometimes twelve meters in height, with a trunk 0.30 to 0.45 in diameter, or except in the southern states, a low, much branched ; usually on sandy beaches and dry hillsides, reaching its greatest development in the bottoms and rich hummocks of the Georgia and Florida coasts.

Wood, light, soft, strong, brittle, very close-grained, compact ; medullary rays, numerous, thin ; colour, dark brown, the sap-wood lighter ; specific gravity, 0.5637 ; ash, 0.51.

The leaves and stimulant and astringent bark of the roots sometimes employed by herbalists. The wax which covers the small globular fruit, formerly largely collected and made into candles, and now, under the name of myrtle-wax, a popular remedy in the treatment of dysentery. 177, 137, 119, 151.

"Leaves, lanceolate, pointed, serrated, flat, somewhat shining. A large evergreen shrub. Flowers, reddish green ; May or June. Fruit, white ; ripe in October."—*L.*

Seeds, sown in autumn ; transplanted at eighteen months. Soil, moist and sandy.

CUPULIFERÆ.

Quercus Alba. (White Oak.)

Northern Maine, valley of the Saint Lawrence River, Ontario, lower peninsula of Michigan to southeastern Minnesota, south to the Saint John's River and Tampa Bay, Florida ; and west to the valley of the Nodaway River, Missouri, western Arkansas and the valley of the Brazos River, Texas.

A large tree, of the first economic value, twenty-four to forty-five meters in height, with a trunk 1.20 to 2.40 meters in diameter ; all soils ; very common and reaching its greatest development along the western slopes of the Alleghany Mountains, and in the valley of the Ohio River, and its tributaries, here often forming more than half the forest growth.

Wood, strong, very heavy, hard, tough, close-grained, liable to check unless carefully seasoned, durable in contact with the soil ; layers of annual growth strongly marked by several rows of large open ducts ; medullary rays, broad, prominent ; colour, brown, the sap-wood lighter brown ; specific gravity, 0.7470 ; ash, 0.41 ; largely used in shipbuilding, construction of all sorts, cooperage, in the manufacture of carriages, agricultural implements, and baskets, and for railway ties, fencing, interior finish, cabinet-making, fuel, etc.

A decoction of the astringent bark is employed medicinally in cases of hemorrhage, dysentery, etc. 76, 104, 85, 82.

"Leaves, oblong, pinnatifidly serrated ; pubescent underneath ; lobes, linear-lanceolate ; obtuse, entire, attenuated at the base. Fruit, pedunculated. Calyx, somewhat cup-shaped, warty, and flattened at the base. Acorn, oval. Flowers, greenish white ; April."—*L.*

Seeds sown in November, in rows, transplanted when one year old, and again three years after. Soil, deep, rich, light loam.

"All oaks growing in Canada may be conveniently arranged into two classes, viz., the "white and the "black" oaks. The white oaks are so called, from the grayish or ash-coloured tint of the bark, which often tends to separate into scales. The wood is tough, dense, and excellent for cooperage, waggon-making, and other uses requiring closeness of

grain, strength, and durability. The trees are slower in growth than the other divisions to be mentioned, but owing to the superior quality of the timber, they may prove more profitable for planting, although longer in coming to full maturity. They are excellent for fuel and charcoal, and most of them are desirable for ornamental planting. The black oaks have a bark which is dark, rough, and deeply cracked. The wood is brittle, porous, and a poor fuel. The peduncles, or fruit stems, are short or wanting, and the acorns ripen the second year, but to this there are some exceptions. Their growth, as compared with the white oaks, is very rapid, generally as two to one, or even more. There is generally less distinction between the heart-wood and the sap-wood, and they occur principally in the Atlantic States. They far excel the white oaks in the tanning qualities of the bark."—*Hough*.

Quercus Obtusiloba. (Post Oak. Iron Oak.)

Martha's Vineyard, Massachusetts; south to northern Florida; west through southern Ontario and Michigan to eastern Nebraska; the Indian Territory, and extending to the 100th meridian in central Texas.

A tree, rarely exceeding twenty-four meters in height, with a trunk 0.90 to 1.50 meter in diameter, or on the Florida coast reduced to a low shrub; dry, gravelly uplands, clay barrens, or in the south-west on cretaceous formations; the most common and widely-distributed oak of the Gulf States west of the Mississippi River, forming the principal growth of the Texas "cross-timbers."

Wood, heavy, hard, close-grained, compact, checking badly in drying, very durable in contact with the soil; layers of annual growth marked by one to three rows of not large open ducts; medullary rays, numerous, conspicuous; colour, dark or light-brown, the sap-wood lighter; specific gravity, 0.8367; ash, 0.79; largely used, especially in the south-west, for fencing, railway ties, and fuel, and somewhat for carriage stock, cooperage construction, etc. 37, 169, 100, 108.

"Leaves, oblong, slightly pubescent beneath, sharply wedge-shaped at the base; lobes obtuse, the lower ones deeply sinuated, and the upper ones dilated and slightly bilobed. Calyx hemispherical. Fruit, oval and rather small."—*L*.

Quercus Macrocarpa. (Burr Oak. Mossy-cup Oak. Over-cup Oak.)

Nova Scotia: New Brunswick; northern shores of Lake Huron to Lake Winnipeg; south to the valley of the Penobscot River, Maine; and along the shores of Lake Champlain and the valley of the Ware River, Massachusetts, to Lancaster County, Pennsylvania; west to the eastern foot-hills of the Rocky Mountains of Montana, central Nebraska and Kansas; southwest to the Indian Territory and the valley of the Nueces River, Texas.

A large tree of the first economic value; twenty-four to thirty or, exceptionally, fifty meters in height, with a trunk 1.20 to 2.10 meters in diameters; rich bottoms and prairies; in the prairie region the principal growth of the "oak openings," and extending farther west and north-west than any oak of the Atlantic forests.

Wood, heavy, hard, strong, tough, close grained, compact, more durable in contact with the soil than that of other American oaks; layers of annual growth marked by one to three rows of small open ducts; medullary rays broad and conspicuous; colour, dark, or rich light-brown, the sap-wood much lighter; specific gravity, 0.7453; ash, 0.71; generally confounded with the less valuable white oak, and employed for the same purposes. 82, 122, 65, 103.

"Leaves, downy beneath, lyrate, deeply and sinuately lobed; the lobes obtuse and spreading, and the upper one much dilated. The calyx deep, cup-shaped, scaly, and fringed with bristles. Acorns, thick and ovate."—*L*.

"My experience with the white oak is, that it does grow spontaneously where it has a chance (or is protected), yet does much better when the acorn is planted and nurtured. The soil best adapted to it is a deep gravel, but the swamp or burr oak does better on a low, heavy soil. They can be transplanted from the forest so as to do well, but it costs more than to raise them from the seed."—*D. M. Wigle*, Ruthven.

"Second-growth oak is very numerous on my farm, and I think have all grown from seed since I was a boy, so I have been paying particular attention to them. The large oak will soon be a thing of the past. Roads through the woods, stock trampling, soon caused them to decay at the top limbs, and farmers generally sold them to lumbermen, or mill-men for saw logs. My father tried to preserve some of the giants of the forest, and I felt like carrying out his wishes in the matter, but two years ago I got a very good offer to sell, and sold. I was astonished at the amount of decayed timber there was in the lot. Wherever the top was dead, the decay seemed to work down into the body of the tree. The oak grows on an average, about a quarter of an inch in a year in diameter. Each growth of wood measures from one-sixteenth to one-eighth of an inch, and the largest trees grow even after they are dead at the top."—*Matthew Martin, Fletcher.*

Quercus Vicolor. (Swamp White Oak.)

Southern Maine; valley of the St. Lawrence River; Ontario; southern peninsula of Michigan to southeastern Iowa and western Missouri; south to Delaware, and along the Alleghany Mountains to northern Georgia; northern Kentucky; and northern Arkansas.

A large tree, twenty-four to thirty-two meters in height, with a trunk 1.20 to 2.40 or, exceptionally, over 3 meters in diameter; borders of streams and swamps; in deep alluvial soil; common, and reaching its greatest development in the region south of the great lakes.

Wood, heavy, hard, strong, tough, close-grained, inclined to check in seasoning; layers of annual growth marked by one to three rows of large open ducts; medullary rays, broad and conspicuous; colour, light-brown, the sap-wood hardly distinguishable; specific gravity, 0.7662; ash, 0.58; used for the same purposes as that of the white oak. 60, 131, 81, 102.

"Leaves, almost sessile, obtusely oval, bluntly toothed, downy beneath. The leaves are from six to eight inches long, and four inches broad; entire towards the base, which is attenuated and wedge-shaped, but dilated and coarsely-toothed for two-thirds of their length. The tree is distinguished when fully grown by the remarkable appearance of the leaves, which are on the under side silky and of a silvery whiteness, while the upper side is smooth and of a bright green."—*L.*

Quercus Prinus. (Chestnut Oak. Rock-Chestnut Oak.)

Blue Hills, eastern Massachusetts; west to the shores of Lake Champlain; shores of Quinté Bay; Ontario; and the valley of the Genessee River, New York; south to Delaware; and through the Alleghany region to northern Alabama; extending westward to central Kentucky and Tennessee.

A tree twenty-four to thirty meters in height, with a trunk 0.90 to 1.20 meter in diameter; rocky banks and hillsides; very common, and reaching its greatest development in the southern Alleghany region, here often forming a large portion of the forest growth.

Wood, heavy, hard, strong, rather tough, close-grained, inclined to check in drying, durable in contact with the soil, containing few open ducts; medullary rays, very broad, conspicuous; colour, dark-brown, the sap-wood lighter; specific gravity, 0.7499; ash, 0.77; largely used in fencing, for railway ties, etc.

The bark, rich in tannin, is largely used in preference to that of other North-American white oaks in tanning leather. 75, 27, 48, 67.

"Leaves, on longish foot-stalks, obovate; fruit very large; cup moderately hollow, distinctly scaly. The leaves are of a shining green above, and whitish, and somewhat wrinkled underneath, and are from eight inches to nine inches long and from four inches to five inches broad, and terminating in an acute point. They are somewhat wedge-shaped and are deeply dentated with blunt lobe-like teeth from the summit to the base."—*L.*

Quercus Prinoides. (Yellow Oak. Chestnut Oak. Chinquapin Oak.)

Eastern Massachusetts ; shores of Lake Champlain ; west along the northern shores of Lake Ontario and Erie ; through southern Michigan to eastern Nebraska ; eastern Kansas and the Indian Territory ; south to Delaware and through the Alleghany region to northern Alabama and Mississippi ; south-west to the Guadalupe Mountains, western Texas.

A tree, twenty-four to thirty or, exceptionally, thirty-nine meters, with a trunk 0.60 to 0.90 meter in diameter, or often, especially toward the eastern and western limits of its range, reduced to a low slender shrub ; dry hillsides, and low rich bottoms ; rare, except as a shrub, east of the Alleghany Mountains ; very common in the Mississippi River basin, and reaching its greatest development in southern Arkansas.

Wood, heavy, hard, strong, very close-grained, checking badly in drying ; very durable in contact with the soil ; layers of annual growth marked by rows of small open ducts ; medullary rays broad, conspicuous ; colour, dark-brown, the sap-wood much lighter ; specific gravity, 0.8605 ; ash, 1.14 ; used for cooperage, wheel stock, fencing, railway ties, etc. The small acorns sweet and edible. 31, 53, 6, 44.

"Leaves, on shortish petioles ; somewhat lanceolate ; glaucous beneath ; regularly, but not deeply dentated, of a light green above, and whitish beneath. The acorns are enclosed for about one-third of their length, in scaly sessile cups ; they are of the middle size, somewhat elongated, similarly rounded at both ends, and very sweet. Highly ornamental when in bloom, and most prolific in acorns, even when only three or four feet high."—*L.*

Quercus Rubra. (Red Oak, Black Oak.)

Nova Scotia ; southern New Brunswick to eastern Minnesota ; western Iowa, eastern Kansas, and the Indian Territory ; south to northern Florida, southern Alabama, and Mississippi, and the valley of the San Antonio River, Texas.

A large tree, twenty-four to thirty, or, exceptionally, forty-five meters in height, with a trunk 1.20 to 2.10 meters in diameter ; very common, especially at the north, in all soils, and extending farther north than Atlantic oak.

Wood, heavy, hard, strong, coarse-grained, inclined to check in drying ; layers of annual growth marked by several rows of large, open ducts ; medullary rays, few, conspicuous ; colour, light-brown or red, the sap-wood somewhat darker ; specific gravity, 0.6540 ; ash, 0.26 ; now largely used for clapboards, cooperage, and somewhat for interior finish, in the manufacture of chairs, etc. 129, 48, 63, 83.

"Leaves, smooth, oblong, sinuated on long stalks ; lobes, acute, sharply-toothed, bristle-pointed. Calyx of the fruit flat underneath. Nut, ovate. Flowers, greenish-white ; May. Acorns, brown, occasionally ripened in England, in October."—*L.*

Quercus Coccinea. (Scarlet Oak.)

Southern Maine to northern New York ; Ontario ; northern Michigan and Minnesota ; eastern Iowa and northeastern Missouri ; south to Delaware and southern Tennessee, and through the Alleghany region to northern Florida.

A tree, twenty-four to thirty or, exceptionally, fifty-four meters in height, with a trunk rarely exceeding 0.60 to 1.20 meter in diameter ; at the east in dry, sandy soil, or, less commonly, in rich, deep soil ; in the northwestern prairie region forming the oak-opening growth ; not common, and reaching its greatest development in the basin of the lower Ohio River.

Wood, heavy, hard, strong, coarse-grained ; layers of annual growth strongly marked by several rows of large open ducts ; medullary rays, thin, inconspicuous ; colour, light-brown or red, the sap-wood rather darker ; specific gravity, 0.7405 ; ash, 0.19. 84, 65, 38, 87.

"Leaves, smooth, oblong, deeply and widely sinuated on long stalks ; lobes, divaricated, acute, sharply-toothed, bristle-pointed. Calyx of the fruit turbinate, half as long as the nut. The leaves begin to change with the first cold, and, after several successive frosts, turn to a brilliant scarlet. These leaves differ very greatly in shape at different stages in the growth of the tree."—*L.*

Quercus Tinctoria. (Black Oak, Yellow-bark Oak, Quercitron Oak, Yellow Oak.)

Southern Maine to northern Vermont; Ontario, southern Minnesota, eastern Nebraska, eastern Kansas, and the Indian Territory; south to the Chattahoochee region of western Florida, southern Alabama and Mississippi, and eastern Kansas.

A large tree, twenty-four to thirty-six or, exceptionally, forty-eight meters in height, with a trunk 0.90 to 1.80 meter in diameter, generally on dry or gravelly uplands; very common.

Wood, heavy, hard, strong, not tough, coarse-grained, liable to check in drying; layers of annual growth marked by several rows of very large, open ducts; colour, bright-brown, tinged with red, the sap-wood much lighter; specific gravity, 0.7045; ash, 0.28; somewhat used for cooperage construction, etc.

The bark largely used in tanning; the intensely bitter inner bark yields a valuable yellow dye, and is occasionally used medicinally in the form of decoctions, etc., in the treatment of hemorrhage. 106, 81, 44, 92.

"Leaves, downy beneath, obovate, oblong, dilated, widely sinuated; lobe, short, obtuse, slightly toothed, bristle-pointed. Calyx of the fruit flat underneath. Nut, globose."—L.

Castanea Vulgaris. (Chestnut.)

Southern Maine to the valley of the Winooski River, Vermont; southern Ontario and southern Michigan; south through the northern States to Delaware and southern Indiana, and along the Alleghany Mountains to northern Alabama, extending west to middle Kentucky and Tennessee.

A large tree, twenty-four to thirty meters in height, with a trunk 1.80 to four meters in diameter; rich woods and hillsides; very common, and reaching its greatest development on the western slopes of the northern Alleghany Mountains.

Wood, light, soft, not strong, coarse-grained, liable to check in drying, easily split, very durable in contact with the soil; layers of annual growth marked by many rows of large, open ducts; medullary rays, numerous, obscure; colour, brown, the sap-wood lighter; specific gravity, 0.4504; ash, 0.18; largely used in cabinet-making, for railway ties, posts, fencing, etc.

The fruit, although smaller, superior in sweetness and flavour to that of the European chestnut.

An infusion or fluid extract of the dried leaves is successfully employed in the treatment of whooping-cough, and other pectoral affections. 247, 152, 184, 222.

"A large tree. Leaves, oblong, lanceolate, pointed, coarsely and sharply serrate, acute at the base. Nuts, two or three in each burr."—S.

Seeds sown late in the fall; transplanted at one year, and again at three or four years. Soil, a deep, dry, sandy loam.

"The chestnut is early to feel the warmth of spring, and sometimes suffers from late spring frosts. For this reason it is least apt to suffer on a northern or northeastern slope. It requires a light, silicious soil if deep and substantial, and especially prefers that formed by the decomposition of granite, gneiss, mica, slate or sandstone. Upon granite, gravel, and volcanic scorial, it gives the most abundant products. It is useless to plant it upon calcareous soils, nor does it prosper upon clay or in marshy and undrained situations. It prefers hills and mountains of moderate height, and succeeds much better there than upon plains. For cultivation as a timber-tree it should be planted upon gravelly hills, and generally where it is to remain. The young plants are robust from the first, and do not prosper in the shade. They are more apt to suffer from frost than the oak. The roots are generally abundant, and strike deep into the soil, but not as deep as the oak. The growth is rapid, and sustained till sixty or seventy years of age, but it continues to live and grow to more than twice this period, and under favourable circumstances it sometimes lives to an immense age."—Hough.

"Grows fast and thrives well when transplanted or raised from the nut. Bear fruit in about ten years from the planting of the nut. I have a few young trees which grow rapidly, but have not yet borne fruit. Some were transplanted from the nursery and

some grown from the nut. Both do equally well. Light soil suits them"—*William Elliot, Parkhill.*

Oaks succeed best on a deep loamy soil, and on low lands rather than upon hills. They are especially liable to injury from late spring frosts, both in the blossoms and leaves, and having a long tap-root, they are somewhat difficult to transplant, without careful preparation, tending to the suppression of this root, and to the formation of abundant fibres. They may be planted in the fall or early spring, in places where they are to remain, and should be cultivated till they shade the ground. When started in nurseries, they should be transplanted two or three times, before final planting and the tap-roots should be cut off with a sharp knife, to induce the formation of lateral roots and more abundant radicles.—*Tough.*

The mode of raising oaks from the acorn is the same in all the species. Sow them in drills, the nuts two inches apart, covered one inch deep, if to transplant. But they are best sown where they are to stand. If the tap-root be cut by a sharp spade, it gives better surface roots.

Æsculus hippocastanum. (Horse Chestnut.)

The horse-chestnut is a tree of the largest size with an erect trunk, and a pyramidal head, sometimes attaining a height of ninety or one hundred feet. The leaves are large, of a deep green, and singularly interesting and beautiful when first developed. When enclosed in the bud they are covered with a pubescence that falls off as they become expanded, which occurs sooner or later according to the dryness or moisture of the season. The buds are covered with a gummy substance which protects their downy interior from the wet. The growth, both of the tree and of the leaves, is very rapid, sometimes the young shoots and leaves being perfected in three weeks from the time of their first unfolding. The flowers appear a short time after the leaves, and are white variegated with red and yellow; and in Britain and the northern parts of the United States they expand in May, and the fruit ripens about the end of September, or early in October. It requires a deep, free, loamy soil, and will neither attain an ample size, nor flower freely except in a situation rather sheltered than exposed. It is always propagated by the nut, sown in autumn or spring, and covered with from two to three inches of soil. The cotyledons do not rise to the surface as in the oak, the beech, and some other trees. "Some nursery-men," says Loudon, "cause the nuts to germinate before sowing them, in order to have an opportunity of pinching off the extremity of the radicle, by which means the plants are prevented from forming a tap-root, or at least if a tap-root is formed, it is of a much weaker description than it would otherwise be, and the number of lateral fibres is increased; all of which is favourable for transplanting when the tree is intended to attain the largest size in the shortest time; the nut ought to be sown where the tree is finally to remain, because the use of the tap-root is mainly to descend deep into the soil to secure a supply of water, which, in dry soils and seasons, can never be obtained in sufficient quantities by the lateral roots, which extend themselves near the surface in search of nourishment and air. This is admitted by Selby to be the case for a certain number of years, but he doubts whether a transplanted tree will not ultimately attain as large a size as one reared in the manner recommended above. He cites an instance of a tree at Twizell eighteen years planted which measured at two feet from the ground, four feet two inches, in circumference, with a height of thirty-eight feet. Its wood is white, and very soft, and according to Loudon, when dry, weighs from thirty-five to thirty-seven pounds to a cubic foot. It is unfit for use where much strength and durability in the open air are required; nevertheless, there are many purposes for which it is applicable when sawn into boards; such as for flooring, lining to carts, packing cases. In France, sabots, or wooden shoes are made from it, and it is said to be used by carvers and turners. Boucher says that it is suitable for water-pipes that are to be kept constantly underground; and it is also recommended for this purpose by Du Hamel. The charcoal made of this species may be used in the manufacture of gunpowder; and the ashes of every part of the plant, more especially of the fruit, afford potash in considerable quantity. The bark, which is very brittle, is employed for tanning, and also for dyeing yellow; and it has been used medically as a substitute for Jesuits' bark. In

Turkey the nuts are ground and mixed with horse flesh, especially when the animals are broken-winded; and in their crude state they are eaten by goats, sheep, deer and hogs. They are used in Ireland to whiten linen, and for this purpose are rasped into water in which they are allowed to macerate for some time. The saponaceous juice which they contain is very useful, not only in bleaching, but in washing linen and other stuffs. The nuts must be peeled and ground, and the flour of twenty of them is sufficient for ten quarts of water; and either linens or woollens may be washed with the infusion without any soap, as it effectually eradicates spots of all kinds. The clothes, however, should afterwards be rinsed in clean water. The nut when ground into flour, and mixed in the proportions of one-third with the flour of wheat, is said to add to the strength of book-binder's paste; it makes a nutritious food for pigs and poultry. M. Vergaud has proposed to change the starch contained in the flour, into sugar, and afterwards employ it in distillation.—*Browne*.

Fagus Ferruginea. (Beech.)

Nova Scotia and the valley of the Restegouche River to the northern shores of Lake Huron and northern Wisconsin, south to the Chattahoochee region of western Florida, and the valley of the Trinity River, Texas west, to eastern Illinois, south-eastern Missouri, and Madison County, Arkansas.

A large tree, twenty-four to thirty, or, exceptionally, thirty-four meters in height, with a trunk of 0.90 to 1.20 meter in diameter; rich woods, or at the south sometimes in bottom lands or the dryer portions of swamps, reaching its greatest developments upon the "bluff" formations of the lower Mississippi basin; very common.

Wood, very hard, strong, tough, close-grained, not durable in contact with the soil, inclined to check in drying, difficult to season, susceptible of a beautiful polish; medullary rays, broad, very conspicuous; colour varying greatly with soil and situation, dark red, or often lighter, the sap-wood nearly white; specific gravity 0.6883; ash, 0.51; largely used in the manufacture of shoe-lasts, chairs, plane-stocks, handles, etc., and for fuel. 120, 32, 18, 120.

"A very common tree in rich woods, the branches horizontal. Leaves, oblong, ovate, taper-pointed, toothed, the very straight veins terminating in the teeth."—*S*.

Seeds sown in March, transplanted at two years, and again two years later. Succeeds best on dry, light, chalky soil."

"The beech is termed "red" or "white" by woodmen, from the difference in colour of the heart-wood; and they appear to be simply varieties of the same species, from the differences in the soil or exposure. The red beech is much more durable, and under water it appears almost indestructible. It is also been found durable in plank-roads, and in ship-building where permanently under water, and for this reason it is sometimes used for the keels of vessels. A very simple method is employed for preserving the nuts for planting. They are gathered, spread in an airy place, turned daily to allow of moderate drying, and then left on a floor under a covering of straw to keep from frost. With the greatest care it is sometimes difficult to keep them alive from fall till spring. The nuts should be planted like corn, and when up, should be carefully hoed, taking care to cover the seminal leaves, leaving only the proper leaves above ground. If planted in fall, as is preferable, the seed will sprout in the spring following. Owing to the difficulty of getting plants started from the seed, it is common to seek the young plants where they have been self-sown in the woods, set them in nursery rows, and transplant when of sufficient size. These seed-plants are best taken up with a trowel, and a cool, cloudy time should be chosen for the operation."—*Hough*.

Ostrya Virginica. (Hop Hornbeam. Iron Wood, Lever Wood.)

Bay of Chaleur, through the valleys of the Saint Lawrence, and the lower Ottawa Rivers, along the northern shores of Lake Huron to northern Minnesota, south through the northern States, and along the Alleghany Mountains to the Chattahoochee region of western Florida, and through eastern Iowa, southeastern Missouri, and Arkansas, to eastern Kansas, the Indian Territory, and eastern Texas.

A small tree, nine to fifteen meters in height, with a trunk 0.30 to 0.60 meter in diameter; generally on dry, gravelly hillsides and knolls, reaching its greatest development in southern Arkansas; common.

Wood, heavy, very strong and hard, close-grained, compact, susceptible of a beautiful polish, very durable in contact with the soil; medullary rays, numerous, obscure; colour light brown, tinged with red, or like the sap-wood, often nearly white; specific gravity, 0.8284; ash, 0.50; used for posts, levers, handles of tools, etc. 40, 15, 23, 64.

"A slender tree, with brownish furrowed bark. Leaves oblong, ovate, taper-pointed, sharply, doubly serrate. Fertile catkin like a hop in appearance. Wood, very hard and close."—*S.*

Is a tree of spreading roots; and therefore delights in a soil of thin humus, resting on a hard subsoil; rarely exceeds eight to ten inches at the butt. When from one and a half to two inches in thickness the five feet next the root, a portion of which he utilizes in order to give him a bending chisel point, forms the favourite handspike of the back-woodsman. The long, straight, tough shaft, where four or five inches in thickness, he uses for many purposes in rough carpentry, sledge, or waggon work, and the first four-foot cut, three feet from the butt, makes fair axe-handles where hickory or rock elm cannot be had. Sow either fall or spring, transplant in a year; rich shallow soil.

Carpinus Caroliniana. (Hornbeam, Blue Beech, Water Beech, Iron Wood.)

Nova Scotia, southern New Brunswick, northern shores of Georgian Bay, southern peninsula of Michigan to northern Minnesota, south to Cape Malabar, and Tampa Bay, Florida, and the valley of the Trinity river, Texas, west to central Iowa, eastern Kansas, and the valley of the Poteau River, Indian Territory.

A small tree, nine to fifteen meters in height, with a trunk sometimes 0.60 to 0.90 meter in diameter; or at the north much smaller, and often reduced to a low shrub; borders of trees and swamps, in moist soil; most common, and reaching its greatest development along the western slopes of the southern Alleghany Mountains, and in southern Arkansas, and eastern Texas.

Wood, heavy, very strong, hard, close-grained, inclined to check in drying; medullary rays, numerous, broad; colour, light brown, the thick sap-wood nearly white; specific gravity, 0.7286; ash, 0.83; sometimes used for levers, handles of tools, etc. 92, 43, 18, 96.

"Small trees with furrowed trunks, and close smooth gray bark. Leaves oblate, oblong, pointed, doubly serrate. Resembling a beech in general aspect, but with inflorescence like that of ironwood."—*S.* Growth as last, but deeper soil.

BETULACEÆ.

Betula alba. (White Birch, Old-field Birch, Gray Birch.)

New Brunswick, and the valley of the lower St. Lawrence River to the southern shores of Lake Ontario, south, generally near the coast, to New Castle county, Delaware.

A small, short-lived tree of rapid growth, six to nine meters in height, with a trunk 0.30 to 0.45 meter in diameter; dry, gravelly, barren soil, or borders of swamps, now generally springing up on abandoned or burned land in eastern New England.

Wood, light, soft, not strong, close-grained, liable to check in drying, not durable; medullary rays, numerous, obscure; colour, light brown, the sap-wood nearly white; specific gravity, 0.5760; ash, 0.29; largely used in the manufacture of spools, shoe-pegs, wood-pulp, etc.; for hoop-poles, and fuel.

The bark and leaves are popularly esteemed as a remedy for various chronic diseases of the skin, bladder, etc.; and for rheumatic and gouty complaints; the empyreumatic oil of birch obtained from the inner bark by distillation is used externally and internally

for the same purposes; the bark occasionally used domestically in the manufacture of ink. 168, 214, 140, 254.

"Leaves, small, somewhat triangular and tapering, very smooth and glossy. Stem with chalky-white, paper-like bark, readily peeling horizontally in thin sheets."—*F.*

Seeds sown in March, in light soil—transplanted at one year, and again two or three years later. Dry, sandy soil.

"Readily propagated from seed, but does best on new ground, and can hardly be made to grow where nursery trees have previously been raised. The seeds scarcely admit of any covering, and if simply pressed into the ground with the feet they will grow. A bushel of seed will stock thirty linear yards of a seed bed four feet wide. When a year old they may be transplanted to nursery rows, and when two or three feet high, may be set for permanence. The seeds of the birch and alder scatter very soon after they ripen, and it is difficult to keep them. They should be gathered by hand just as the burrs begin to turn brown, and if possible, should be sown the same year. An expeditious way to obtain the seed is to cut off the branches that bear the burrs, at the time when they are just ripening, and hang them in a dry place till the seed falls out. As they should be covered but very slightly, they are best raked in upon soil previously prepared, and if sown in autumn, they will start the next spring."—*Hough.*

Betula papyrifera. (Canoe Birch, White Birch, Paper Birch.)

Northern Newfoundland and Labrador to the southern shores of Hudson's Bay, and northwest to the Great Bear Lake, and the valley of the Yukon River, Alaska, south, in the Atlantic region to Wading River, Long Island, the mountains of northern Pennsylvania, Clear Lake, Montcalm county, Michigan, northeastern Illinois, and St. Cloud, Minnesota; in the Pacific region south to the Black hills of Dakota, the Mullen trail of the Bitter Root Mountains and Flathead Lake, Montana, the neighbourhood of Fort Colville, Washington Territory, and the valley of the lower Fraser River, British Columbia.

A tree, eighteen to twenty-four meters in height, with a trunk 0.60 to 0.90 meter in diameter; rich woodlands or banks of streams; very common in the northern Atlantic region, and reaching a higher latitude than any deciduous tree of the American forest.

Wood, light, hard, strong, tough, very close-grained, compact; medullary rays, numerous, obscure; colour, brown tinged with red, the sap-wood nearly white; specific gravity, 0.5955; ash, 0.25; largely used in the manufacture of spools, shoe-lasts, and pegs, in turnery, for fuel, wood-pulp, etc.

The very tough, durable bark, easily separated into thin layers, impervious to water, is largely used in the manufacture of canoes, tents, etc. 159, 18, 37, 109.

"Leaves, ovate or heart-shaped, dark green on the upper side. Wood, white, compact, hard, making excellent fuel, and is also used for the same purposes as the white birch."—*F.*

Betula Lutea. (Yellow Birch, Gray Birch.)

Newfoundland; northern shores of the Gulf of St. Lawrence to Abittibi Lake, and the western shores of Lake Superior and Rainy Lake; south through the northern States to Delaware and southern Minnesota, and along the Alleghany Mountains to the high peaks of North Carolina and Tennessee.

One of the largest and most valuable deciduous trees of the northern New England and Canadian forests, often twenty-one to twenty-nine meters in height, with a trunk 0.90 to 1.20 meter in diameter; rich woodlands; common.

Wood, heavy, very strong and hard, very close-grained, compact, satiny, susceptible of a beautiful polish; medullary rays, numerous, obscure; colour, light-brown, tinged with red, the heavier sap-wood nearly white; specific gravity, 0.6553; ash, 0.31; largely used for fuel, in the manufacture of furniture, button and tassel moulds, pill and match boxes, and for the hubs of wheels. 127, 3, 5, 29.

"Bark of the trunk, yellowish-grey, somewhat silvery, scaling off in thin layers. Leaves, hardly at all heart-shaped. Fruiting catkins, thick and short."—*S.*

Betula Lenta. (Cherry Birch, Black Birch, Sweet Birch, Mahogany Birch.)

Newfoundland and the valley of the Saguenay River ; west through Ontario to the Manitou Islands of Lake Huron ; south to northern Delaware and southern Indiana, and along the Alleghany Mountains to the Chattahoochee region of southern Florida, extending west to middle Kentucky and Tennessee.

A tree, eighteen to twenty-four meters in height, with a trunk 0.90 to 1.20 meter in diameter ; rich woodlands ; very common in all northern forests.

Wood, heavy, very strong and hard, close-grained, compact, satiny, susceptible of a beautiful polish ; medullary rays, numerous, obscure ; colour, dark-brown, tinged with red, the sap-wood light-brown or yellow ; specific gravity, 0.7617 ; ash, 0.26 ; now largely used in the manufacture of furniture and for fuel ; in Nova Scotia and New Brunswick, largely in ship-building.

Birch beer is obtained by fermenting the saccharine sap of this and, perhaps, some other species of the genus. 64, 10, 9, 31.

"Bark of the trunk, dark-brown, close, aromatic, that of the twigs bronze-coloured. Wood, rose-coloured. Leaves, ovate, with somewhat heart-shaped base, doubly serrate, pointed, short petioled. Fruiting catkins, sessile, thick, oblong, cylindrical."—*S.*

SALICACEÆ.

Salix Nigra. (Black Willow.)

Southern New Brunswick, and the northern shores of Lakes Huron and Superior ; southward through the Atlantic region to Bay Biscayne and the Calossa River, Florida, and the valley of the Guadalupe River, Texas ; Pacific region valleys of the Sacramento River, California, and the Colorado River, Arizona.

A small tree, sometimes fifteen to eighteen meters in height, and a trunk rarely 0.60 meter in diameter, or in southern Florida ; usually along the banks of streams ; most common in the basin of the Mississippi River, and reaching its greatest development in the rich bottom lands of the Colorado and other rivers of eastern Texas ; varying greatly in the size and shape of the leaves, length and habit of the aments, etc.

Wood, light, soft, weak, close-grained, checking badly in drying ; medullary rays, obscure ; colour, brown, the sap-wood nearly white ; specific gravity, 0.4456 ; ash, 0.70.

The tonic and astringent bark used domestically as a popular febrifuge, and containing, in common with that of all the species of the genus, salicylic acid, a powerful antipyretic now successfully used in the treatment of acute cases of gout, rheumatism, typhoid fever, etc.

"A large tree, with a roughish, black bark, growing along streams. Leaves, narrowly lanceolate, tapering at each end, serrate, smooth, green on both sides. Stamens, 3-6."—*S.*

Easily propagated by cuttings in the spring ; can be transplanted in the fall.

Salix Amygdaloides. (Willow.)

Shores of the great lakes (Wayne County, New York ; Painsville, Ohio) ; westward to the valley of the Saskatchewan, and southward through the Rocky Mountain region to southern New Mexico ; banks of the lower Columbia River.

A small tree, rarely nine to twelve meters in height, with a trunk 0.15 to 0.30 meter in diameter ; along streams.

Wood, light, soft, not strong, close-grained, checking in drying ; the heart-wood light-brown, sap-wood nearly white ; specific gravity, 0.4509 ; ash, 0.92. 251, 277, 257, 291.

WILLOWS.

Among the willows of large growth, the white willow is by far the most important. It is sometimes called the gray or Huntingdon willow, and is already widely introduced in the prairie region of the northwest, where it is valued above all others as a wind-break.

The white willow is found to thrive exceedingly well in northern Iowa and in Minnesota, as a hedge and screen. It grows with great rapidity, and its wood is useful as a fuel, and, when peeled and seasoned, as poles for all kinds of farm uses. When split and nailed to posts, it makes a very good fence. This willow is readily propagated from cuttings, as already described, and they should be set in soil liable to draught, and so thick that they will shade the ground early, but care should be taken to thin them out as soon as they become crowded. The willows occur in a great variety of soil, but generally prefer humid localities, and many kinds occur chiefly along the borders of streams. Their roots in such places present the most efficient means of preventing erosions, and they may be planted for this purpose with great success. Willows produce seeds much like those of the poplars, and these ripen in the spring. They are, however, best propagated from cuttings from the robust young wood or in sections from the roots. These cuttings may be made late in the fall and winter, but always after the fall of the leaf, and before the sap starts in the spring. They should be selected from sound and thrifty young wood of the previous year's growth, tied in bundles and set in a damp cellar, their lower ends set in sand or wet moss, and their tops prevented from drying; or, instead of this, they may be set in trenches not liable to standing water, and covered from the frost. They should be set early in spring, in ground previously prepared, and will need cultivation till they are above the reach of weeds.

Populus tremuloides (Aspen. Quaking Asp.)

Northern Newfoundland and Labrador to the southern shores of Hudson Bay, northwest to the Great Bay Lake, the mouth of the Mackenzie River, and the valley of the Yukon River, Alaska; south in the Atlantic region to the mountains of Pennsylvania, the valley of the lower Wabash River, and northern Kentucky; in the Pacific region south to the valley of the Sacramento River, California, and along the Rocky Mountains and interior ranges to southern New Mexico, Arizona, and central Nevada.

A small tree, fifteen to eighteen meters in height, with a trunk rarely exceeding 0.60 meter in diameter; very common through British America, and spreading over enormous areas bared by fire of the coniferous forest; in the Pacific region very common upon moist mountain slopes and bottoms, at an elevation of 6,000 to 10,000 feet; the most widely-distributed North American tree.

Wood, light, soft, not strong, close-grained, compact, not durable, containing, as does that of the whole genus, numerous minute, scattered, open ducts; medullary rays, very thin, hardly distinguishable; colour, light brown, the thick sap-wood nearly white; specific gravity, 0.4032; ash, 0.55; largely manufactured into wood-pulp, a substitute for rags in the manufacture of paper; in the Pacific region sometimes used for fuel, flooring in turnery, etc.

A bitter principle in the bark causes its occasional use as a tonic in the treatment of intermittent fever. 275, 180, 198, 266.

"A tree with greenish-white bark, and roundish heart-shaped leaves continually in a state of agitation, due to the lateral compression of the petiole, and the consequent susceptibility of the leaf to the least motion of the air. Teeth of the leaves small."—S.

Propagated chiefly from suckers, which should be planted in nursery rows for a year or two when they can be again transplanted. Thrives on any moderate soil of a wet nature.

Populus grandidentata (Poplar).

Nova Scotia, New Brunswick, and west through Ontario to northern Minnesota, south through the northern States, and along the Alleghany Mountains to North Carolina, extending west to middle Kentucky and Tennessee.

A tree twenty-one to twenty-four meters in height, with a trunk 0.60 to 0.75 meter in diameter; rich woods and borders of streams and swamps.

Wood, light, soft, not strong, close-grained, compact, medullary rays thin, obscure; colour, light brown, the sap-wood nearly white; specific gravity, 0.4632; ash, 0.45;

largely manufactured into wood-pulp, and occasionally used in turnery for woodenware, etc. 234, 108, 169, 243.

"Leaves three to five inches long, roundish-ovate, with large irregular sinuate teeth, and, when young, densely covered with white silky wool, but becoming smooth on both sides. A large tree, sixty to eighty feet high, with rather smoothish gray bark."—*F.*

Propagated chiefly from cuttings, which are fit for final transplantation after one year in the nursery bed. Soil, good moist loam.

Populus monilifera (Cottonwood. Necklace Poplar. Carolina Poplar. Big Cottonwood.)

Shores of Lake Champlain, Vermont, south through western New England to the Chatahoochee region of western Florida, west along the northern shores of Lake Ontario to the eastern base of the ranges of the Rocky Mountains of Montana, Colorado and New Mexico.

A large tree, twenty-four to fifty-one meters in height, with a trunk 1.20 to 2.40 meters in diameter; low, moist soil; the common cottonwood of Texas and the western plains bordering all streams flowing east to the Rocky Mountains.

Wood, very light, soft, not strong, close-grained, compact, liable to warp in drying, difficult to season; medullary rays numerous, obscure; colour, dark brown, the sap-wood nearly white; specific gravity, 0.3889; ash, 0.96; largely used in the manufacture of paper-pulp, for light packing cases, fence boards, and fuel. 281, 98, 145, 249.

"Twigs and smaller branches thick, smooth, but sharply angled or winged. Leaves large, six to nine inches long, broadly heart-shaped, smooth, sharply serrate, with slightly incurved teeth. Fertile catkins very long, with scales finely fringed, but not hairy."—*F.* By cuttings, but better by the growing plants found along rivers.

Populus Balsamifera (Balsam. Tacamahac. Balm of Gilead.)

Straits of Belle Isle to Richmond Gulf and Cape Churchill, Hudson Bay, northwest to the shores of the Great Bear Lake and the valley of the Yukon River, Alaska, south to northern New England, central Michigan and Minnesota, the Rocky Mountains and the interior ranges of Montana and Idaho, Washington Territory, and British Columbia.

A large tree, eighteen to twenty-four meters in height, with a trunk 1.50 to 2.10 meters in diameter; very common on all islands and shores of the northern rivers, in British Columbia generally confounded with the allied *P. trichocarpa*, the range of the two species here still uncertain.

Wood, very light, soft, not strong, close-grained, compact; medullary rays, numerous, very obscure; colour, brown, the thick sap-wood nearly white; specific gravity, 0.3635; ash, 0.66.

The buds, as well as those of several other species, covered with a resinous exudation, and occasionally used medicinally as a substitute for turpentine and other balms. 288, 150, 257, 271.

"Leaves ovate, gradually tapering and pointed, sometimes heart-shaped, finely serrate, smooth on both sides. Branches round, buds large, and covered with a fragrant resinous matter, which appears to become volatile on the approach of warm weather, and is widely diffused."—*F.*

CONIFERÆ.

Thuja occidentalis. (White Cedar, Arbor Vitæ.)

New Brunswick to Anticosti island, through the valley of the Saint Lawrence River to the southern shores of James' Bay, and southeast to the eastern extremity of Lake Winnipeg, south through the northern States to central New York, northern Pennsylvania, central Michigan, northern Illinois, central Minnesota, and along the Alleghany Mountains to the high peaks of North Carolina.

A tree, twelve to eighteen meters in height, with a trunk sometimes 1.20 to 1.50 meter in diameter; cold, wet swamps and along the rocky banks of streams; very common

at the north, spreading over great areas of swamp; extensively cultivated as a hedge and ornamental plant, and producing innumerable seminal varieties of more or less horticultural value.

Wood, very light, soft, not strong, brittle, rather coarse-grained, compact, very durable in contact with the soil; the bands of small summer cells, very thin, dark coloured; medullary rays, numerous, indistinct; colour, light brown, turning darker with exposure; the thin sap-wood nearly white; specific gravity, 0.3164; ash, 0.37; largely used for posts, fencing, railway ties, and shingles.

The distilled oil and a tincture of the leaves have been found useful in the treatment of pulmonary and uterine complaints. 297, 271, 267, 275.

"Leaves quite small, rhombic, ovate, imbricated in four rows. Branches numerous, slender, upright, or widely spreading. Cones small, oblong, ovoid, with thin, dry, spreading, pointless scales. Seed, with a broad wing all round. A tree largely employed for screens and ornamental hedges, as it thrives in a great variety of soils."—*F.*

Seeds sown in April, transplanted into rows at one year old, to grow there till they are of sizes fit to permanently transplant. Grows well in any moderately good soil.

"Cedars are best propagated from seeds in nurseries, and then transplanted in spring, and should have some shelter on the south side, as every one must have noticed, who has attempted to plant on both sides of a board fence, running east and west. It would be well to provide a row of some other trees for this use, two or three years before the cedar is set, and take it away when no longer needed. This tree, when cut back, will thicken up very well at the bottom. When set, it should be well watered, and if followed by a dry summer, the watering should be repeated till the plants get well rooted."—*Hough.*

Juniperus Virginianæ. (Red Cedar, Savin.)

Southern New Brunswick, to the northern shores of Georgian Bay, northern Michigan, Wisconsin, and Minnesota, south to Cape Malabar, and Tampa Bay, Florida, and the valley of the Colorado river, Texas, west to eastern Nebraska, Kansas, and the Indian Territory, to about the one hundredth parallel of west longitude; in the Pacific region, mountains of Colorado, to Vancouver's Island, British Columbia; not extending to western Texas, California or Oregon; in Utah, Nevada, and Arizona, rare and local.

The most widely distributed of North American Coniferæ, a tree, twenty-four to thirty meters in height, with a trunk 0.60 to 1.35 meter in diameter; or towards its northern and western limits much smaller, often reduced to a low shrub; dry, gravelly ridges and limestone hills, or in the Gulf States, especially near the coast, in deep swamps; in northern Montana, borders of streams and lakes; common; and reaching its greatest development in the valley of the Red river, Texas.

Wood, light, soft, not strong, brittle, very close and straight-grained, compact, easily worked, very durable in contact with the soil; odorous; bands of small summer cells rather broad, conspicuous; medullary rays, numerous, very obscure; colour, dull red, the thin sap-wood nearly white; specific gravity, 0.4926; ash, 0.13; largely used for posts, sills, railway ties, interior finish, cabinet-making, and almost exclusively for lead-pencils. A decoction of the leaves is occasionally used as a substitute for savine cerete, and an infusion of the berries as a diuretic. 212, 238, 158, 177.

"Leaves, very small, scale-like on the older branches, but larger on the young twigs or branchlets; very numerous, closely imbricated, and of a dark green colour. Branches usually horizontal, but in some soils upright, covered with a thin, scaly bark. Fruit, small, dark purple, covered with a whitish bloom."—*F.*

Transplant this, and all evergreens, the first week in June, i.e., before growth commences, or the first in August, when it is about over. The first date is best; the tree is then full of sap.

Pinus Strobus. (White Pine, Weymouth Pine.)

Newfoundland, northern shores of the Gulf of Saint Lawrence, to Lake Nepigon and the valley of the Winnipeg River, south through the northern States to Pennsylvania, the

southern shores of Lake Michigan, "Starving Rock," near La Salle, Illinois, near Davenport, Iowa, and along the Alleghany Mountains to northern Georgia.

A large tree, of the first economic value, twenty-four to fifty-two meters in height, with a trunk 1.50 to 3.50 meters in diameter; sandy loam upon drift formations, forming extensive forests, or in the region of the great lakes, often in small bodies scattered through the hardwood forests, here reaching its greatest development; north of latitude 47° north and south of Pennsylvania, central Michigan, and Minnesota, much smaller, less common and valuable.

Wood, light, soft, not strong, very close, straight-grained, compact, easily worked, susceptible of a beautiful polish; bands of small summer cells, thin, not conspicuous, resin passages small, not numerous or conspicuous; medullary rays, numerous, thin; colour light brown, often slightly tinged with red, the sap-wood nearly white; specific gravity, 0.3854; ash, 0.19; more largely manufactured into shingles, laths, etc., than that of any other North American tree; the common and most valuable building material of the northern States; largely used in cabinet-making, for interior finish, and in the manufacture of matches, woodenware, and for many domestic purposes. 282, 154, 225, 212.

"Leaves, slender, without sheaths. Male catkins small. Cone, cylindrical, long and pendulous. Buds, ovate pointed, and slightly resinous; surrounded by one or two small buds. Seed, obovate, pointed below with a wing, which, including the seed, is about one inch long, and one-quarter inch broad in the widest part. Cotyledons, six to ten."—*L.*

Seeds sown in spring, transplanted at one year, and again two years later. Grows best on gravelly loam; will grow on most soils.

"A hardwood land, here north of Frontenac, it seems to me, when burnt over in spring, and left undisturbed, springs up in hardwood; but if after the first of August in evergreen."—*R. Flynn*, Mountain Grove.

"Where we find pine growing exclusively together it is generally sandy soil, and they do not attain to so large a size as those which grow scattered and intermingled with other kinds of timber both hard and softwood; they then are to be found on all kinds of soil, often heavy clay. We find very few young pines growing in the primeval forest. The pines there, although of various dimensions, appear to be of the same age, but as soon as any clearing is made, and left uncultivated, young pines spring up from the seed, and numerous groves originated in this way are to be found. These trees, when transplanted young as windbreaks or shade trees, succeed well. One grove of this description cut down last winter, was about forty years old, and some of the trees were fifteen to eighteen inches in diameter; the owner was building, and had them converted into lumber for that purpose."—*John Darby*, Crown Hill.

"In reference to the growth of the white pine, which I have observed closely, I find it succeeds and grows more rapidly on a sandy loam than other soils, and would recommend it as a favourable species for transplanting. Pine seedlings do well if protected from cattle. I know of a piece of land on which the old residents say about fifty years ago, there grew a superior crop of rye, which is now covered by a beautiful grove of white pine, many trees of which will measure sixty feet in height, and from eight to fifteen inches in diameter, which must have been propagated from seed."—*W. J. Westington*, Plainville.

Pinus resinosa. (Red Pine, Norway Pine.)

Newfoundland, northern shores of the Gulf of St. Lawrence, and Lake Nepigon to the valley of the Winnipeg River, south through the northern States to Chestnut Hill, Middlesex county, Massachusetts, the mountains of northern Pennsylvania, Isabella County, Michigan, and central Minnesota.

A large tree, twenty-four to sixty-four meters in height, with a trunk 0.60 to 1.37 meter in diameter; light, sandy loam, or dry, rocky ridges, forming scattered groves rarely exceeding a few hundred acres in extent; common, and reaching its greatest development through northern Wisconsin and Minnesota; rare in the eastern States, except in the extreme northern portions of New England.

Wood, light, not strong, hard, rather coarse-grained, compact; bands of small summer cells broad, dark coloured, very resinous, resin passages few, small, not conspicuous;

medullary rays, numerous, thin : colour, light red, the sap-wood yellow, or often almost white ; specific gravity, 0.4854 ; ash, 0.27 ; largely manufactured into lumber, and used for all purposes of construction, flooring, piles, etc. 217, 51, 131, 140.

“ Bark, red, leaves in pairs from four and a half to five and a half inches long ; straight, rigid and yellow at the tips, dark green in colour. Sheath nearly one inch long, and lacerated. Cones about half the length of the leaves, of a reddish brown colour, ovate conical, and rounded at the base ; generally in clusters, and with very short foot-stalks. Buds, long—usually one and a half inch—acute, resinous.”—*B.*

Propagation same as white.

Pinus rigida. (Pitch Pine.)

Valley of the St. John's River, New Brunswick, to the northern shores of Lake Ontario, south through the Atlantic States to northern Georgia, extending to the western slope of the Alleghany Mountains in west Virginia and Kentucky.

A tree, twelve to twenty-four meters in height, with a trunk 0.60 to 0.90 meter in diameter ; dry, sandy, barren soil, or less commonly in deep, cold swamps ; very common.

Wood, light, soft, not strong, brittle, coarse-grained, compact ; bands of small summer cells broad, very resinous, conspicuous, resin passages numerous, not large ; medullary rays, numerous, obscure ; colour, light brown, or red, the thick sap-wood yellow, or often nearly white ; specific gravity, 0.5151 ; largely used for fuel, charcoal, and occasionally manufactured into coarse lumber. 197, 261, 158, 245.

“ Leaves, in threes, and from three to five inches long, from very short sheaths, rigid and flattened, or slightly angled on one side, of a bright, but not very dark green colour. Cones ovoid, conical. Seeds, small, winged.”—*F.*

Seeds treated as those of white pine. Soil, light, friable and deep.

Pinus Banksiana. (Gray Pine, Scrub Pine, Prince's Pine.)

Bay of Chaleur ; New Brunswick ; to the southern shores of Hudson's Bay, northwest to the Great Bear Lake, the valley of the Mackenzie River, and the eastern slope of the Rocky Mountains, between the fifty-second and sixty-fifth degrees of north latitude ; south to northern Maine, Ferrisburg, Vermont, the southern shore of Lake Michigan and central Minnesota.

A small tree, nine to twenty-two meters in height, with a trunk rarely exceeding 0.75 meter in diameter ; barren, sandy soil, or, less commonly, in rich loam ; most common north of the boundary of the United States, and reaching its greatest development in the region north of Lake Superior, here often forming considerable forests.

Wood, light, soft, not strong, rather close grained, compact ; bands of small summer cells not broad, very resinous, conspicuous, resin passages few,—not large ; medullary rays, numerous, obscure ; colour, clear light brown, or, rarely orange, the thick sap-wood nearly white ; specific gravity, 0.4761 ; ash, 0.23 ; largely used for fuel, railway ties, etc. 225, 118, 214, 201.

“ Leaves in twos, from a very short sheath, only an inch long, quite rigid, and evenly distributed, and of a grayish green colour. Cones about two inches long, ovate, conical, curved or bent to one side, smooth, of a light gray colour, scales almost or quite point-less.”—*F.*

Plant as above ; will grow on moist light soils, no matter how poor.

Picea nigra. (Black Spruce.)

Newfoundland, northern Labrador to Ungava Bay, Nastapokee Sound, Cape Churchill, Hudson Bay, and northwest to the mouth of the Mackenzie River, and the eastern slope of the Rocky Mountains, south through the northern State to Pennsylvania, central Michigan, Wisconsin, and Minnesota, and along the Alleghany Mountains to the high peaks of North Carolina.

A tree, fifteen to twenty-one meters in height, with a trunk 0.60 to 0.90 meter in diameter : light, dry, rocky soil, forming, especially north of the fiftieth degree of lati-

tude, extensive forests on the water-sheds of the principal streams, or in cold, wet swamps, then small, stunted, and of little value.

Wood, light, soft, not strong, close, straight-grained, compact, satiny; bands of small summer cells thin, resinous, resin passages few, minute; medullary rays, few, conspicuous; colour light red, or often nearly white, the sap-wood lighter; specific gravity, 0.4584; ash, 0.27; largely manufactured into lumber, used in construction, for ship-building, piles, posts, railway ties, etc.

Essence of spruce, prepared by boiling the young branches of this species, is used in the manufacture of spruce beer, a popular beverage. 237, 60, 156, 193.

"Leaves about half an inch long, stiff, and somewhat quadrangular, very dark green. Cones ovate, or ovate-oblong, dull, reddish-brown when mature. Scales very thin, roundish, with an uneven margin. Seeds small, with rigid wings."—*F.*

Seeds sown in April—transplanted after two years, and again after two, three, or four years, according to size of required plants. Soil, deep, rich, and somewhat moist.

Picea Alba. (White Spruce.)

Newfoundland, northern shore of Labrador, to Ungava Bay, Cape Churchill, and northwestward, to the mouth of the Mackenzie River, and the valley of the Yukon River, Alaska; south to the coast of Maine, northeastern Vermont, northern Michigan, Minnesota to Moose Lake, and the White Earth Indian reservation, the Black Hills of Dakota, along the Rocky Mountains of northern Montana, to the valley of the Blackfoot River, Sitka and British Columbia.

A tree fifteen to fifty meters in height, with a trunk 0.60 to 0.90 meter in diameter; low, rather wet soil, borders of ponds and swamps; most common north of the boundary of the United States, and reaching its greatest development along the streams and lakes of the Flathead region of northern Montana at an elevation of 2,500 to 3,500 feet; the most important timber tree of the American sub-arctic forests north of the sixtieth degree of latitude, here more generally multiplied, and of larger size than the allied *P. nigra*, with which it is associated; its distribution southward in British Columbia not yet satisfactorily determined.

Wood, light, soft, not strong, close, straight-grained, compact, satiny; bands of small summer cells, thin, not conspicuous, resin passages few, minute; medullary rays numerous, prominent; colour, light yellow, the sap-wood hardly distinguishable; specific gravity, 0.4051; ash 0.32; largely manufactured into lumber, although not distinguished in commerce from that of the black spruce. 273, 90, 153, 256.

"Leaves needle-shaped, four-angled, one-half to an inch long, and distributed all around the branch, those on the underside curving upward; of a light silvery green colour. Cones one to two inches long, oblong-cylindrical, with entire scales. Seeds small, with thin wings about three-eighths of an inch long."—*F.*

Cultivate as white.

Tsuga Canadensis. (Hemlock.)

Nova Scotia, southern New Brunswick, valley of the St. Lawrence River to the shores of Lake Temiscaming, and southwest to the western borders of northern Wisconsin, south through the northern States to New Castle County, Delaware, southeastern Michigan, central Wisconsin, and along the Alleghany Mountains to Clear Creek Falls, Winston County, Alabama.

A tree twenty-one to thirty-three meters in height, with a trunk 0.90 to 1.15 meter in diameter: dry, rocky ridges, generally facing the north and often forming extensive forests, almost to the exclusion of other species, or, less commonly, borders of swamps in deep, rich soils: most common at the north, although reaching its greatest individual development in the high mountains of North Carolina and Tennessee.

Wood, light, soft, not strong, brittle, coarse, crooked-grained, difficult to work, liable to wind-shake and splinter, not durable; bands of small summer cells rather broad, conspicuous; medullary rays, numerous, thin; colour light-brown tinged with red, or often

nearly white, the sap-wood somewhat darker ; specific gravity 0.4239 ; ash 0.46 ; largely manufactured into coarse lumber, and used in construction, for outside finish, railway ties, etc. Two varieties, red and white, produced apparently under precisely similar conditions of growth, are recognized by lumbermen.

The bark, rich in tannin, is the principal material used in the United States in tanning leather, and yields a fluid extract sometimes used medicinally as a powerful astringent.

Canada or hemlock pitch, prepared from the resinous secretion of this species, is used in the preparation of stimulating plasters, etc. 258, 135, 171, 219.

"Leaves, linear, a half-inch long, flat, obtuse, dark green above, and whitish beneath. Cones three-quarters of an inch long, oval, composed of a few roundish, oblong, thin scales. Seeds, quite small with thin wings."—*F.*

These seeds are treated the same as those of the black and white pines. Soil, deep, and porous.

"The hemlock is a tree not much found on soil such as we have in Markham, but rather on sandy or loamy soil, where it attains to a considerable size in the early forest. My experience, however, of the second growth is that it is very shy and slow. I have some of twenty-five years growth which are mere bushes yet, though very pretty as shrubbery. It would be entirely useless to plant for timber."—*John Gibson, Milliken.*

Abies Balsamea. (Balsam Fir, Balm of Gilead Fir.)

Northern Newfoundland and Labrador to the southern shores of Hudson Bay, northwest to the Great Bear Lake and the eastern base of the Rocky Mountains, south through the northern States to Pennsylvania, central Michigan and Minnesota and along the Alleghany Mountains to the high peaks of Virginia.

A tree, twenty-one to twenty-seven meters in height, with a trunk rarely exceeding 0.60 meter in diameter, or at high elevations reduced to a low prostrate shrub, damp woods and mountain swamps.

Wood, very light, soft, not strong, coarse-grained, compact, not durable, bands of small summer cells, not broad, resinous, conspicuous ; medullary rays, numerous, obscure ; colour, light brown, often streaked with yellow, the sap-wood yellow, lighter ; specific gravity, 0.3019 ; ash, 0.45.

Canadian balsam or balm of fir, an aromatic liquid, oleo-resin, obtained from this and other species of balsam by puncturing the vesicles formed under the bark of the stem and branches, is used medicinally, chiefly in the treatment of chronic catarrhal affections. 283, 177, 265, 236.

"Leaves, flat, the lower surface whitish, and the mid-rib prominent, crowded, pointing mostly right and left on the branches, violet-coloured, the scales slender, pointed."—*S.*

Moist soil is best, but will grow well on dry. Transplant first week in June.

Larix Americana. (Larch, Black Larch, Tamarack, Hackmatack.)

Northern Newfoundland and Labrador to the eastern shores of Hudson Bay, Cape Churchill and northwest to the northern shores of the Great Bear Lake and the valley of the Mackenzie River within the Arctic circle, south through the northern States to northern Pennsylvania, northern Indiana and Illinois, and central Minnesota.

A tree, twenty-four to thirty meters in height, with a trunk 0.60 to 0.90 meter in diameter ; moist uplands and intervalle lands, or north of the boundary of the United States in cold, wet swamps, often covering extensive areas, here much smaller and less valuable.

Wood, heavy, hard, very strong, rather coarse-grained, compact, durable in contact with the soil, bands of small summer cells broad, very resinous, dark coloured, conspicuous, resin passages few, obscure ; medullary rays, numerous, hardly distinguishable, colour light brown, the sap-wood nearly white ; specific gravity, 0.6236 ; ash, 0.33 ; preferred and largely used for the upper knees of vessels, for ship timbers, fence posts, telegraph poles, railway ties, etc.

The inner bark of the closely allied European larch is recommended in the treatment of chronic catarrhal affections of the pulmonary and urinary passages, probably that of the American species would be equally efficacious. 153, 23, 90, 58.

"Leaves, from $\frac{1}{2}$ to $\frac{3}{4}$ of inch long, slender and thread-like, light bluish green. Cones about an inch long, ovoid, scales few, slightly reflexed and rounded. Seeds small with short thin wings."—*F.*

"The European or common white larch (*Larix Europæa*), called by Linnaeus *Pinus Larix*, is a native of the Swiss Alps, of other mountainous districts towards the north of Europe, and of some districts in the north of Asia, and was introduced from Germany into Britain about the year 1629. Its trunk is straight and tall, and its outline is conical or pyramidal. Its branches grow in a remotely whorled arrangement, and for the most part spread horizontally from the trunk, but occasionally, and especially when old, are somewhat pendulous. Its leaves are linear, soft, rounded or blunt at the point, and of a pleasant light-green colour, spreading and slightly recurved round a central bud, or bunched together with a somewhat similar appearance to the pencils or little brushes of the painter. The male catkins are stalkless, somewhat globular, and of a bright yellow colour, and are shed in April and May. The female flowers or embryo cones vary from a whitish to a bright reddish colour, and appear about the same time as the male catkins. The cones are erect, fully an inch long, of an oblong-ovate form and deepen in colour as they ripen. The cone scales are persistent, roundish and striated, while the bractæas, especially those towards the lower part of the cones, are generally longer than the scales. The seeds are fully an eighth of an inch long, and have an irregular or ovate form, and each has from five to seven cotyledons, and is more than half enveloped in a persistent, smooth, shining perisperm. Certain it is, that this is an excellent wood for ship and house building. At Venice the wood is often used for building houses, as well as in Switzerland, where these trees abound, and without doubt the larch excels for ship masts, beams for houses and doors, windows, etc., particularly as it is said to resist the worm. In Switzerland the houses are covered with boards of this wood, cut out a foot square, and as it emits a resinous substance, this resin so diffuses itself into every joint and crevice and becomes so compact and close, as well as so hardened by the air, as to be proof against the weather. The wood when first laid on, is said to be very white, but this colour changes in two to three years to black, which then appears like a smooth shining varnish. Its merits are stated to have been known at the time of Julius Cæsar, who calls it "*lignum igni impenetrabile*." But the merit of making known its actual properties as a timber tree for the climate of Britain is due to the Duke of Athole."—*Michie*.

In planting the European larch, only such trees should be set out as have been once transplanted. Their growth the first year or two is very slow, and in exposed situations they are liable to suffer from the winds. As the leaves appear early, it must be planted as soon as the ground can be prepared, and great care should be taken to protect the roots from the air. They may be dipped to advantage in a mud, composed of a rich mellow soil and water, of about the thickness of white-wash. The tops should remain dry and the roots damp, till they are finally set.

Where the larch is cultivated in masses and kept of one age, it not injurious to pasture with cattle after a certain time. A woodland of this timber will in some regions pasture one cow to a hectare (about $2\frac{1}{2}$ acres) through the summer. In a genial soil and climate the larch is aggressive, and tends continually to spread over the neighbouring fields, especially on the side opposite to that of the prevailing winds. From this tendency to seeding, it is easy to re-stock a forest, by leaving here and there a sufficient number of seed trees, and by raking the surface here and there so that the seeds can find fresh soil to sprout in.

MEANING OF TECHNICAL EXPRESSIONS.

A

- Accessory*, something added to the usual number of organs.
Acerose, slender or needle-shaped, as in the leaves of some of the cone-bearing trees.
Acuminated, having a taper point.
Acute, sharp-pointed.
Adnate, grown to for its whole length.
Aggregate, clustered.
Alburnum, the sap-wood of trees.
Alveolate, honeycomb-like.
Ament, a catkin, or inflorescence consisting of chaffy scales, arranged along a thread-like receptacle.
Angulate, having acute angles.
Anthers, the part of the stamen which contains the pollen.
Apex, the end or termination.
Apiculated, terminated in a little point or prickle.
Appendicled, having an additional small leaf at the base of the petiole.
Approximate, near to.
Arborescent, having a tendency to become a tree.
Argutely, sharply.
Arrow-shaped, lobed so as to resemble a barbed arrow.
Assurgent, becoming erect.

B

- Baccate*, berry-like; that is, with the seeds buried in a fleshy substance, enclosed in a thin outer skin.
Bicuspidate, having two points.
Bibracteate, having two bracteas.
Bipinnate, twice pinnate.
Biternate, twice ternate.
Bractea, the floral leaf, situated immediately under the flower.
Bracteate, furnished with bracteas.
Bracteole, a small bractea.

C

- Caducous*, falling off soon; a calyx which falls off before the expansion of the corolla is said to be caducous.
Calyculate, having bracteas so disposed as to resemble an additional calyx.
Calyx, the outer envelope of a flower.
Capillary, hair-like, very slender.
Canescent, somewhat white, hoary.
Capsule, a dry fruit containing several seeds.
Cartilaginous, gristly; a cartilaginous leaf has the edge strengthened by a tough rim of a substance different from that of the disk.
Carpel, an individual part of a compound fruit.
Catkin. See ament.
Cerebriform, having an irregular, brain-like appearance, as the kernel of a walnut.
Cohering, connected.
Collateral, side by side, parallel.
Comose, covered with small tufts of hair, called coma.
Concave, more or less hollowed.
Conical, cone-shaped.
Conjugate, joined by pairs; a pinnate leaf is conjugate when it has but one pair of leaflets.
Contorted, twisted.
Convex, the reverse of concave.
Convolute, rolled together.

- Cordate*, heart-shaped; in the outline resembling that of a heart in cards.
Cordate-ovate, heart-shaped; rounded at the apex into an egg-shaped form.
Coriaceous, leathery.
Corymb, a kind of umbel with the stalks of the outer flowers longer than those of the centre, so as to form a level head.
Corolla, the inner envelope of a flower.
Cotyledons, leaves enclosed in the seed; which serve to elaborate the sap, before the expansion of the true leaves.
Crenate, scalloped, having round notches.
Cruciform, cross-shaped; a cruciform flower consists of four petals placed in opposite directions.
Cunate, wedge-shaped.
Cuticle, the skin or epidermis.
Cylindrical, cylinder-shaped, round.
Cyme, a kind of umbel, with the stalks of the outer flowers shorter than those in the centre.
Cymose, flowering in cymes.

D

- Dehiscent*, opening naturally.
Dentate, marginal, teeth-like incisions.
Denticulate, having the margins finely and slightly toothed.
Dilated, widened.
Disk, the fleshy annular process that surrounds the ovary in many flowers; a receptacle adhering to the calyx; also the surface of a leaf.
Distichous, two-ranked or two-rowed, produced in opposite rows.
Divaricate, spreading widely in different directions.
Diverging, going far from one point.
Dorsal, situated upon the back.
Drupe, a fruit consisting of a fleshy substance enclosing a hard stone, as the cherry.

E

- Echinate*, covered with prickles like a hedgehog.
Elliptic, oval, twice as long as broad, and about of equal roundness at both ends.
Elongate, lengthened out.
Emarginate, having a small notch in the centre of the end or tip.
Embryo, the young plant in the seed.
Endocarp, the inner membrane of fruit which forms the cells.
Entire, without margin or incisions.
Epicarp, the external integument of the fruit.
Epigynous, situated upon the style or ovary.
Eroded, gnawed, irregularly toothed.

F

- Falcate*, bent like a sickle.
Farinaceous, floury.
Fasciculate, disposed in bundles.
Fibrous, composed of fibres.
Filament, the thread like part of the stamen which supports the anther.
Filmy, having a thin skin.
Flaccid, flabby, not firm.
Floccose, woolly.
Floriferous, bearing flowers.
Foliate, having leaflets.
Fungus, having the consistency of mushrooms.

G

Gemnacous, having buds.
Germen, the thick part of the pistil.
Glabrous, smooth, without hairs.
Gland, a secretory vessel.
Glaucescent, or *Glauous*, somewhat hoary, or having a bluish green or sea-green appearance.
Glumaceous, having husks.
Granulated, covered as if with grains.
Gynobasic, having a fleshy receptacle, bearing separate fruits.

H

Hemispherical, half-round.
Hermaphrodite, a flower is so called when it consists of both male and female organs.
Heterogamous, flowers of different sexes in the same head.
Hirsute, hairy.
Hispid, covered with bristle-like hairs.
Homogamous, all the flowers hermaphrodite.
Homogynous, all the flowers female.
Hypogynous, situated below the ovary.

I

Imbricate, laid over each other like tiles.
Incumbent, lying upon.
Indehiscent, not opening naturally.
Indurate, hard.
Inflorescence, shape of the flowers.
Internodes, the place between the joints in stems.
Intorse, turned inwards.
Involucl, a small involucre.
Involucre, two or more bractes united below the flower.
Involucriform, resembling an involucre.

J

Jagged, coarsely cut.
Jointed, having joints or articulations.

K

Keel-shaped, having a keel-like appearance.
Kneed, bent like the knee joint.

L

Labiata, having a lip or lips.
Lamina, the upper spreading part of a petal.
Lanceolate, lance or spear-shaped.
Lanuginous, slightly woolly.
Lateral, on the side or sides.
Leaflet, a small leaf, forming part of a compound leaf.
Legume, a pod; the fruit of leguminous plants.
Linear, narrow, when the two sides are nearly parallel.
Linear-cuneate, between linear and wedge-shaped.
Lobe, the segment of a divided leaf.
Loment, a kind of pod, which, when ripe, falls in pieces at the joints.
Lucid, shining.
Lunulate, half-moon-shaped.
Lyrate, a leaf is lyrate when its apex is rounded, and there are several small lateral lobes towards its base; harp or lyre-shaped.

M

Medullary rays, rays of condensed cellular tissue from the centre towards the outside.
Membranaceous, of a thin, pliable texture.

Monopetalous, having but one petal, or having the petals united so as to appear but one.
Mucilaginous, of a slimy nature.
Mucro, a sharp rigid point.
Multifid, many-cleft.
Muricate, covered with short sharp points.
Mutic, pointless, a term opposed to mucro.

N

Navicular, boat shaped.
Nectariferous, having nectaries, bearing honey.
Nucamentaceous, having catkins.
Nucleus, the kernel of a nut.
Nucule, a small nut.
Nutant, nodding.

O

Ob-ovate, inversely, egg-shaped.
Obcordate, inversely heart-shaped.
Obcuneate, wedge-shape inverted.
Ob lanceolate, inversely lance-shaped.
Oblate, flattened.
Oblique, not direct or parallel.
Oblong, two or three times longer than broad.
Obtuse, blunt.
Ochrea, membranous stipules surrounding the stem and cohering by their anterior margins.
Octandrous, having eight stamens.
Obicular, circular, spherical.
Orthrotopous, straight, and having the same direction as the body to which it belongs.
Ovoid, *Ovate*, egg-shaped.
Ovulum, incipient seed.

P

Paleaceous, having or abounding in chaffy scales.
Palmate, palm-shaped, divided so as to resemble the hand spread open.
Panicle, a loose, irregular mode of inflorescence, similarly disposed to that of many grasses, as oats.
Parietal, attached to the sides or walls of the ovary.
Pectinate, comb-shaped.
Pedicel, the flower-stalk of each separate flower.
Peduncle, the principal flower-stalk.
Pellucid, transparent, bright.
Pentagonal, five-angled.
Pentandrous, having five stamens.
Pentapetalous, five-petaled.
Perianth, the flower-cup; the envelope which surrounds the flower; a term applied when the calyx cannot be distinguished from the corolla.
Pericarp, the covering of the seed vessel.
Perigonal, having both calyx and corolla.
Perigynous, inserted in the calyx, or in the disk which adheres to the calyx.
Peripheric, curved, circular.
Petal, a division of corolla.
Petiolate, having petioles or foot-stalks to the leaves.
Petiole, the foot-stalk of a leaf.
Petioleule, the foot-stalk of a leaflet.
Pinnate, a leaf divided into many smaller leaves or leaflets is said to be pinnate.
Pistil, the female organ of fructification; always, when present, forming the centre of the flower.
Placenta, the columnar body usually situated in the centre of a flower; when perfect, it consists of the germen, style, and stigma.
Plicate, plaited.
Plumose, bearing a resemblance to feathers, feathery.
Plumule, the ascending shoot of a seedling.

P

- Pod*, a kind of seed-vessel similar to that of the common pea.
Polyandrous, having more than twenty stamens inserted in the receptacle.
Polygamous, producing male, female, and hermaphrodite flowers on the same plant.
Polypetalous, having many petals.
Pome, a fruit composed of the fleshy tubular part of the calyx, and crowned by the persistent limb.
Procumbent, prostrate.
Puberulous, clothed with spreading down.
Pubescent, covered with short hairs.
Putamen, a nut of many cells.
Pyramidal, formed like a pyramid.
Pyriform, shaped like a pear.

Q

- Quadrangular*, having four angles.
Quadriflorous, arranged in four rows, or parts.
Quinquefid, five-parted; divided into four parts.

R

- Raceme*, a mode of inflorescence in which the flowers are arranged round a single filiform axis, each particular flower on its own proper footstalk.
Racemule, a small raceme.
Rachis, the common footstalks of spikes or panicles of flowers, and of compound leaves; the axis of the cone of the silver fir and the cedar.
Radicle, the root of an embryo.
Ramentaceous, having small loose scales upon the stem.
Ramose, branched.
Receptacle, that part of the fructification which supports the other parts.
Reflexed, bent backwards.
Regma, a kind of seed-vessel, three or more celled, few-seeded, superior, dry, the cells bursting from the axis with elasticity into two halves.
Reniform, kidney-shaped.
Repand, when the margin of the leaf has a wavy, undulated appearance, the leaf is said to be repand.
Rhombic, } a figure approaching to a diamond
Rhomboid, } shape.
Ringent, gaping.
Rufescent, somewhat rusty.
Runcinate, cut into several transverse acute segments which point backwards.

S

- Samara*, a kind of winged seed-vessel containing one or more seeds, surrounded or partially surrounded by a thin transparent membrane.
Samarideous, bearing samaræ.
Scabrous, rough from little asperities.
Scandent, climbing.
Secund, arranged on one side only.
Seminiferous, seed-bearing.
Sepaloid, resembling sepals.
Sepals, divisions of the calyx.
Septicidal, dividing at the dissepiments to admit the escape of seeds.
Septiferous, having septa or partitions.
Serrate, like the teeth of a saw.
Sessile, without stalks.

- Setaceous*, resembling a bristle in form.
Setigerous, bearing bristles.
Setose, bristly.
Sheath, the lower part of a leaf or petiole, which surrounds the stem.
Sinuated, cut into scallops.
Spicate, having an inflorescence in which the flowers are sessile or nearly so, upon one long common footstalk or rachis.
Stamen, the male organ of a flower.
Stellate, radiating in a star-like manner.
Stipule, a small leaf or membrane at the base of the petiole.
Style, that part of the pistil which is situated upon the germen, and elevates the stigma.
Suture, the line formed by the cohesion of two parts.

T

- Terminal*, at the end.
Ternate, a leaf of three leaflets is called ternate.
Thryse, } a mode of inflorescence in a dense or
Thrysus, } close panicle, as in the lilac.
Tomentum, down; white hairs closely matted together and soft to the touch.
Tortuous, twisted.
Trifoliolate, having three leaves.
Trigymous, having three styles.
Truncate, blunt, as if cut off.
Tubercle, a little knob.
Turbinate, top-shaped.

U

- Umbellate*, having the flowers in round flat heads, the flower-stalks proceeding from one common centre.
Uctuous, oily, flat.
Undulate, waved.
Unguiculate, furnished with a claw or an unguis, as the petals of the pink.
Urceolar, } Pitcher-shaped.
Ureolate, }
Urtricle, a little bladder.

V

- Valvate*, opening by valves.
Valvular, consisting of valves.
Ventricose, inflated; swelled out.
Vernation, the disposition of the young or growing leaves within the bud.
Verticel, a mode of inflorescence in which the flowers surround the stem in a kind of ring, though not, perhaps, inserted on all sides of it, but merely on two opposite ones.
Villous, clothed with soft, close, loose hairs.

W

- Whorl*, a disposition of leaves or flowers round a stem resembling the spokes round the nave of a wheel.
Wing, a membranous border, a membrane attached to some kind of seeds, by which they are supported in the air when floating from place to place.
Woolly, covered with hairs closely matted together.
Wrinkled, having an equal surface.

Z

- Zigzag*, bending from side to side.

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*Ontario Forestry, Bureau of
Annual report.*

FORESTRY REPORT.

1886.

COMPILED AT THE INSTANCE OF THE GOVERNMENT OF ONTARIO.

BY
R. W. PHIPPS.
TORONTO.



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DESCRIPTION OF CONTENTS.

To the HON. A. M. Ross,

Treasurer and Commissioner of Agriculture.

SIR,—I have the honor to forward my Report on Forestry for the year 1886, which has been delayed rather later than usual, to include certain valuable information obtained last month from the American Forestry Congress and U. S. official sources.

It will be found to contain :—

1. A statement of the amount of firewood yet standing in older settled Ontario, being based on reports from 160 townships.
2. Descriptions of Forestry examinations of two townships—one north and one south—with opinions of most farmers resident therein, and details of observation as to effect of clearing, influence of woods on crops, and value of trees as wind-breaks or otherwise.
3. Correspondence and observations with reference to the pine forests of Ontario, giving descriptions of present method of management, and suggestions of possible improvement.
4. Information as to the progress of Forestry in other countries, with valuable information given at the late Congress in Illinois.
5. Articles on various points of Forestry affecting Ontario, both original and selected, with details of new plantations here, and experiments made.
6. Work done during the year, and recommendations as to further steps desirable to be taken in the interest of Forestry, both in the farming and lumbering districts of Ontario.

Respectfully,

R. W. PHIPPS.

INTRODUCTION.

The fertility of Ontario is greatly affected, as is that of the States of the Union, of late years, by the artificial changes occasioned through settlement here and elsewhere. Fifty years since the sun rose on a different America. The great prairie country was an interminable sea of waving grass, the Northern States largely a forest. All this is now altered. The forests to the south are diminished to comparative nothingness ; and a great expanse to the south, the west, and the north-west—large enough to make half a dozen European kingdoms—has been turned with the plough, and the ponds, streams, and sloughs largely drained. Our own Ontario, then a forest, may, in its more cultivable portions, be considered as cleared. In consequence the winds, from many points, which formerly blew over forest and grass, all of which gave off continual masses of moisture to the atmosphere, now pass over a soil much drier, even heated, which, instead of giving moisture to the passing breeze, absorbs that which it contains. The result is that those breezes, which formerly gave us continuous summer showers, do so no longer. The rainfall is, perhaps, still in equal volume in Ontario, but not equally well distributed, and our forests to the north obtain a moisture which at an earlier day fell closer to the lakes. The result is well known—our harvests are diminished, and our prosperity decreased.

For this there is but one remedy—more general tree-planting here. And here, in this introduction, I would like to suggest to those who are most likely to afford the work the assistance and example it needs—those, I mean, of our farmers who are sufficiently well-to-do to spare the time and cost—that if they will plant each a few acres of trees it will not only beautify and enrich their own farms, but will induce many others to follow in their steps. Many such, I am glad to say, are moving in this direction ; but thousands more are needed. Let me add here an idea well stated of late, “The way to encourage the planting of trees is to plant them.”

In the following pages many facts bearing on these important matters are stated, and the experience of many well-informed individuals given. If those who receive the book will, at their leisure, carefully read these statements, there is every hope that valuable action will be excited. Excellent results have already followed the distribution of this forestry literature both here and elsewhere ; but very much remains to be done before re-planting can to any extent counteract the evils occasioned by the over-clearing hitherto practised throughout all North America where settlement has occurred.

FORESTRY REPORT, 1886.

CHAPTER I.

SUPPLY OF WOOD FOR FUEL IN ONTARIO.

To those who remember the splendid forests of Ontario as they stood in a former day, the apparently interminable supply of bright beech and solid maple, it seems little less than sacrilege to admit the idea that our farmers would ever choose to clear their farms to the uttermost acre, and rely on coal for warming their habitations. There is surely an enchanting remembrance of the wood fire. We think of the road-side tavern, its hearth fronting the blaze of a pile of four foot cordwood; of the evening parlour, and the hickory logs a mass of white hot coals, the cooking of pop corn and the roasting of nuts, prophetic at Halloweve of many a matrimonial future—the bright clear blaze where hemlock snapped and crackled in the early morning, when shivering we came from the upstairs rooms, then ignorant of fire, and all the more healthy therefor—ten thousand pleasant memories throng around the old wood fire. It is much more clean, it is fifty times more healthy than that produced by any coal that ever Lehigh sent. When the passer by looks at a farm, he thinks, “Where is its wood lot—its grove of fuel-providing trees?” If he sees none, and is of my mind, he will say, “What, he has cut down all, and perhaps depends on coal. Pass on; we do not wish to visit him; let a wood fire crackle its welcome to me.”

There is a great portion of Ontario which, if its own reserves of firewood were exhausted, would be too far from the back country to draw its supply thence. That is to say, when these reserves no longer afford a supply, it will be cheaper to buy coal than to pay for the carriage of firewood to this part of the country. How decidedly this will be the case, will be at once understood when it is shown that in townships where railway facilities are plenty, it is now cheaper, in many instances, to buy coal than to purchase wood, although the latter can be cut close at hand, or bought at a low rate. The townships so situated would be in number probably somewhat less than two hundred, which would cover all the most important and older settled portion of Ontario. I have either personally examined, or have had information through the most reliable source, the Township Clerk, from the large majority of these, and following will be found a summary from

about 160 of them, the object being to ascertain how long a supply of firewood will be obtainable within their borders. From this may be obtained an idea of the fuel now existing therein, and its probable duration. It will be observed that many state that with care a certain duration may be expected; and others allow for the increase, and growth of the younger wood. As has been often proved by experience, of which I have published many instances, if a portion of forest in good condition—where not shallow-rooted or especially exposed to being blown down—have cattle excluded from it, the undergrowth will preserve the bush in a perpetual state of vigor, and young trees will be ready to take the place of the old. Such a forest can yearly be drawn upon for firewood in considerable quantities, without injury to the bush resulting. But this is the case in no great proportions of our woods; cattle are too often allowed full range; and the opinions expressed, as to the supply of firewood here given, are based on this too general state of affairs, and the likelihood of forest survival under it:—

BRUCE.

Saugeen.—6,572 acres; no coal used; hard times would increase wood-cutting.

Brant.—17,370 acres bush.

Eastnor.—Half bush.

Greenock.—8,267 acres bush, 9,187 swamp, mostly timbered; wood largely shipped out of township; no coal used.

Amabel.—Supply sufficient for thirty years; no coal used.

Bruce.—One-sixth yet in bush; no coal used; standing timber rapidly blowing down.

Carrick.—18,033 acres yet in bush, about $22\frac{1}{2}$ acres for each family, including those in villages; little coal used; forty years' supply.

Lindsay.—Twenty years' supply; no coal used.

Arran.—14,000 acres wood; calculation, 700 dwellings, using about 12,000 cords 4-ft. wood per year; little coal.

Elderslie.—14,212 acres wood; coal not used; large quantities sold to villages and R.R. stations yearly, still supply for a long time, if properly managed.

Huron.—Little coal used; all timber nearly exhausted; township drawing firewood from adjoining townships.

Kinloss.—Supply about twenty to twenty-five years; probably 5,000 acres good bush.

Culross.—Some coal used in villages; 6,805 acres of wood, besides swamp.

BRANT.

South Dumfries.—8,048 acres of wood; number of families, 796; allowing one-fifth of woodland to be used for farm purposes, leaves 6,438 acres for firewood; suppose each acre will turn off twenty-five cords of wood (the woods on farms being nearly all culled) will make 160,950 cords of wood, and if each family consumes ten cords per annum, will give a little over twenty years' supply. I think the above calculation is not far from the actual state of the matter, the woods having been thinned out very much for timber for farm use, and also the best timber has been sold to the mills, to be made into lumber, so that the woodland will not yield more than one-third of what it would in its primeval state. Coal is largely used through the township, perhaps one-half of the population using coal for at least half of their fuel; of course this is only an approximation, but I do not think it is far from the truth. It is a great pity that our farmers do not plant trees, many parts of their farms being only adapted for that, and not arable, especially along creeks with steep banks. They complain that their fathers cut down all the woods; but they do not move an inch to mend the matter.

Onondaga.—Little coal used ; no uncleared farms ; some farmers are preserving their wood, some few have none ; on the whole, twenty years' supply.

Burford.—Fifty years' supply, if coal were not used ; considerable, however, is used both in the villages and on farms.

DUFFERIN.

Mulmur.—Little coal used ; 10,000 acres wood ; should supply present population thirty or forty years,

Mono.—By assessment roll, 11,520 acres wood ; but do not think this is correct, as the assessors estimate the cleared land, and set down the balance as wood and swamp ; probably no scarcity for twenty years ; little coal used ; a few have coal stoves for parlors, etc.

East Garafraxa.—On an average, one-tenth is wood ; coal little used.

East Luther.—Assessed at 8,677 acres wood and swamp ; marsh and waste land, 12,864 acres ; probably twenty-five or thirty years' supply ; some coal used.

Melancthon.—No coal used ; twenty-five years' wood.

DURHAM.

Cartwright.—6,731 acres wood ; coal little used ; wood getting very scarce ; hardwood in this remote section, \$3 to \$4 per cord.

Darlington.—9,733 acres uncleared ; but it must be understood that much of this, so returned, is run over, and is but a good pasture for cattle ; coal is used as wood decreases of wood, about ten years' supply remains.

Clarke.—About ten years' supply ; a quantity of coal is used.

ELGIN.

Aldborough.—Assessed woodland, 33,226 acres ; and 36,342 cleared. These quantities are deceptive, woodland being ascertained by deducting the supposed quantity of tilled land from the total owned by each person assessed. For instance, a lot, 200 acres, has, say fifty acres under crop, and fifteen acres in old fallow, choked up with young second-growth, which will be cleared up as opportunity affords, but at present it ranks as woodland, although worthless, and not intended for future preservation. Would rather not make calculation ; very little coal used.

South Dorchester.—Little coal used ; would think there is wood for seventy-five years.

Dunwich.—Nearly every farm of 100 acres has a fine reservation of twenty or thirty acres ; no coal used ; the wood will last many years.

GREY.

Sarawak.—Coal not used ; 1,000 acres of bush.

Glenelg.—Little coal burnt ; 14,000 acres of bush, calculated to last present population eighty-four years.

Normanby.—From sixteen to twenty acres are yet standing on farms of 100 acres, on an average. There are 10,315 acres of wood which, if properly managed, is expected to last for generations.

Proton.—24,000 acres of wood ; the stock of firewood, therefore, will take long to exhaust ; the rapid disappearance of the forest, however, is injuring our climate. I think our public schools might wisely turn some attention to arboriculture.

Bentinck.—No coal used ; 23,543 acres of wood.

St. Vincent.—Could not estimate ; think one-fourth of the township yet in bush.

Keppel.—No coal used ; at the present rate all our soft wood will be gone in four or five years for saw-logs ; but the township has so much stony land covered with maple, that its supply of firewood seems inexhaustible.

Artemesia.—28,000 acres of wood, enough, therefore, for a great number of years.

Egremont.—Farms will probably average fifteen acres of wood, enough, perhaps, for thirty years ; coal is not used on the farms, but is in all the principal stores of the town.

Derby.—16,451 acres of wood ; being near Owen Sound, much of this will be consumed there ; coal not used.

Collingwood.—The exact length of time the bush would last is a difficult problem to solve, as there is a great amount of bush land held for the timber to be used in different ways ; I should judge about 15,000 acres in the township. The assessment roll never gives the proper answer to the question, "How much cleared land?"

Sullivan.—No coal used ; probably twenty-five years' wood standing.

Osprey.—Three-sevenths yet wood ; many years' supply ; no coal used.

HALDIMAND.

North Cayuga.—The calculation asked is difficult ; probably one-eighth yet in bush.

Dunn.—No coal used ; each 100 acres has about thirty acres of wood left ; enough, if preserved, for forty years or over.

Seneca.—Coal little used ; fifteen or twenty years' wood.

Canborough.—About fifteen years' wood ; little coal used. If no more care be taken of the forest, in about twenty years it will be a prairie in this township.

Moulton.—Our woods might last for fifty years, but there is as much sold each year as is consumed in the township ; and a great portion is liable, as heretofore, to be killed by fire.

Oneida.—No coal used yet ; the wood supply will not, with the utmost economy, last more than twenty-five years.

Rainham.—No coal used ; over 5,000 acres of wood standing.

Sherbrooke.—No coal used ; wood for twenty-five years.

Walpole.—Little coal used, except in the villages, where one-half use coal ; not more than eighteen or twenty years' supply of wood.

HALTON.

Goderich.—About 11 acres of wood to each eighty-acre lot ; coal is not much used yet, but must be shortly.

Trafalgar.—The consumption of coal will soon be general ; perhaps eleven years' supply of wood.

Nassagaweya.—8,500 acres of hardwood ; allowing forty-three cords to the acre, would give fifty years' consumption.

Esquering.—Coal is used in the villages ; the townships have probably twenty-five years' supply of firewood.

HURON.

Stanley.—Coal little used ; 7,932 acres of bush land, and 432 farms of 100 acres each, on the roll ; allowing each acre of bush to supply fuel for a farm for four years, this would give seventy-three years' fuel.

McKillop.—Our township, containing 52,000 acres, will scarcely average about five acres of bush per hundred acres ; there are a good many farms all cleared, and no bush ; some of my neighbors say that three acres per 100 is a nearer approximation than five ; there is no coal used, except in the villages, coal being cheap.

Hay.—No coal used for domestic purposes ; possibly thirty years' supply of wood standing.

Ashfield.—3,000 acres bush ; coal rarely used.

Steven.—Possibly twenty years' consumption.

Wawanosh West.—Supply for many years, the wood area being large.

Grey.—Fifteen years' consumption ; little coal used.

LEEDS.

Elgin.—Farmers have been very careful of their timber here ; with care there is fifty years' consumption.

North Crosby.—Ten years' supply ; coal much used.

Kitley.—Wood for sixty years.

Front of Leeds and Lansdowne.—Twenty years' supply ; a good deal of coal used.
 Rear of Leeds and Lansdowne.—Many years' timber.
 Rear of Yonge and Escott.—Many years' timber ; wood area large.
 Front of Escott.—Little coal used ; twenty years' wood.

LINCOLN.

Clinton.—Could not calculate ; 3,895 acres assessed, but if all the timber was put on one-third of the land, it would not make a very thick bush.
 South Grimsby.—Some coal used ; acres of woodland, 3,556.
 Grantham.—Acres of woodland, 1,159 ; one-half burn coal.
 North Grimsby.—4,000 acres of woodland ; some coal used.
 Caistor.—Little coal used ; perhaps thirty years' wood.
 Louth.—2,145 acres of woodland ; some coal used.

MIDDLESEX.

Adelaide.—About 11,000 acres, each of which would give thirty cords of wood.
 Nissouri West.—With some parties the wood is nearly exhausted, but as a general thing there is enough to last fifteen or twenty years ; coal is used by some, but people are finding out that it is too expensive. The bush is now preserved as much as possible, and in some instances tree planting is being commenced.
 West Williams.—Assessment returns cannot be depended on. I know many instances where the farmer returned 100 acres of wood, while there are only forty or forty-five. More care is being taken to preserve woods ; probably twenty-five years' consumption here.

Mosa.—Twenty-five or thirty years' consumption.
 North Dorchester.—Our township woods are being taken good care of.
 Westminster.—Twenty years' consumption ; coal is frequently used.
 Metcalfe.—Twenty years' consumption ; no coal used.
 Delaware.—Eighteen years' consumption.
 Ekfrid.—There is hardly any land cleared, except what is cleared by taking wood off, so, in my opinion, it will take at least forty years to use up all the woodland ; and taking into consideration that a good deal of coal may hereafter be used (although little is used now) we may assume that it will take sixty years before all the wood is consumed, and then there may be some left ; no doubt there will.
 Caradoc.—About twenty-five or thirty years' supply.
 Williams East.—Perhaps twenty-five years' consumption.

NORFOLK.

Middleton.—No coal used ; fifty years' supply.
 Woodhouse.—Calculation difficult, as on a good deal of the land returned by the assessor as uncleared, there is no wood on at all ; it has been taken off, and the land is ready to be broken up when the stumps are rotted out.
 Townsend.—Very little coal used ; thirty years' supply of wood.
 Houghton Centre.—No coal used ; there would be many years' supply of wood, but we export it at three points by lake, also, our maple is being used for lumber.
 Charlotteville.—Reported uncleared, 26,000 acres, but the greatest part thin, the timber having been nearly all taken ; perhaps over twenty-five years' supply.
 Walsingham Centre.—Wood, I think, in ten years will be very scarce ; and in twenty, not to be had.

NORTHUMBERLAND.

Cramahe.—One-eighth use coal ; fifteen years' supply of wood.
 Percy.—With care, there should be thirty years' supply.
 Alnwick.—About thirty years' supply.
 Hamilton.—Much coal used in winter ; wood for eight to ten years.
 Seymour.—Little coal used ; 1,900 acres wood.

ONTARIO.

Pickering.—Coal used very extensively; of the township, not one-half is uncleared; about ten years' supply.

Brock.—Probably fifteen years' supply.

Scugog.—Little coal used; probably fifteen years' supply.

Uxbridge.—Over twenty years' supply; little coal used.

Whitby.—Quite an amount of coal used; ten years' supply of wood.

Rama.—I think, in thirteen years from now, firewood will be pretty scarce; quite a number of farms have not enough for five years' supply, and are getting wood where they can. A large portion of the uncleared land is a burnt rock, and burnt over twice at that. The mills are manufacturing all kinds of hard and soft wood; and as is generally the case, people who have marketable stuff are disposing of it as fast as they can take it out. The coal that is burnt in the township is not worth mentioning.

Scott.—Some coal used; twenty-five years' wood.

East Whitby.—Six or seven years' supply; coal is much used.

Mara.—Over half the township uncleared.

Thorah.—Township nine-tenths cleared; probably twenty years' supply of timber: but this will be much lessened by the fact of fire having run through the woods, so that much timber will rot or be otherwise destroyed.

OXFORD.

East Zorra.—Nine-tenths cleared; many have no wood; coal will shortly be used altogether.

South Norwich.—Supply for ten to fifteen years; coal little used.

East Nissouri.—One-ninth woodland; no coal used; perhaps fifteen to twenty years' consumption.

Blenheim.—Much coal used.

PEEL.

Mornington.—Little coal used; average bush, twenty acres to 100; if taken care of and cattle kept out of bush, would last many years, as young timber would be growing.

NOTE.—With such care, many woods would last for ever, but it is rare.

Albion.—Supply of wood, over fifteen years; use of coal increasing.

Caledon.—Some say ten years, others fifteen, with the care now exercised; much coal is used, owing to three railroads running through the township.

Toronto Gore.—Sufficient timber to last for fuel for twelve years; about a third of the farmers have no bush; very little coal used; considerable coal and wood coming in on cars; farmers not saving bush as they did some time ago.

Toronto.—Much coal used; ten or twelve years supply of wood. Quite a number of my neighbors are buying firewood at present.

Chinguacousy.—Probably fifteen years' wood; coal is used extensively.

PERTH.

North Easthope.—Would last many years; in fact, where ordinary care is taken of the woodlands, by properly enclosing it, clearing up and removing all fallen and decaying timber for fuel, there is a better opportunity given to young timber to grow, and it does grow rapidly; in short, when proper care is taken in a twenty-acre lot, the growth of young timber will equal the amount consumed for private use. Coal is not used extensively; possibly twenty per cent. of the farmers use it in hall stoves; it keeps the house comfortable during the long and cold winter nights.

Hibbert.—No coal used; with economy, fifteen to twenty years' supply.

Blanshard.—The timber in this municipality can not last more than fifteen or twenty years at the very most; scarcely any farm has more than ten acres of wood left, and

there being no waste land in the township, you can see that we are near the end. Many of the farmers are using coal in their parlors, in order to make the few remaining trees last as long as possible.

Logan.—In Logan are 53,770 acres; the amount returned to me as being cleared, 40,000 acres; you can add to that, 5,000 acres, which is cleared and not returned, as the farmers all try to return to the assessor as small a clearance as they can, to keep down taxation, that will leave you about, say 9,000 acres of pretty fair timbered lands. I should say that wood will be used as fuel generally for the next fifteen to twenty years. Out of the above 9,000 acres, the Canada Co. own and have in their possession, 5,800 acres, which is very fairly timbered; and as they are not selling land or timber, you will see that they have a very large supply. There is not much coal used in this township.

Elma.—There is a sufficient supply of second-class, or soft wood, for over fifty years; that is, supposing no fire should run through it and burn it down. First-class wood is not in great supply. In our swamp lands, which contain the supply of wood, I am of the opinion that fire will diminish the supply very rapidly, as those lands are all being less or more drained, and when dry are very apt to be overrun with bush fires.

Wallace.—Coal is not used in this township; total acreage, 49,809; acres cleared, 32,591; acres of woodland, 6,675. The farmers are not cutting down timber for clearing, except small parcels, where there is some local cause for it. Besides the acres of woodland given above, there are about 7,000 acres of swamp land, from which a considerable supply of firewood may be gathered.

Ellice.—Supposing the wood in our township was used exclusively for home consumption, the timber would likely last for forty years, if no fire were to destroy it in the meantime, but its likely that fires will occur in the near future, as we have had fires which have burnt down thousands of acres of timber where lumbering has been carried on, and in some places the fires ran into woods which had not been culled, on the low-lying lands, where it will most likely catch again, the first dry summer. Very little coal is used in this township, perhaps not twenty tons in a year.

PETERBOROUGH.

Monaghan, South.—Little coal used; should say fifty years' wood.

PRINCE EDWARD.

South Marysburg.—Little coal used; twenty years' wood.

Sophiasburgh.—Consumption of coal is increasing; fifty years' wood.

North Marysburg.—Probably six or eight years would destroy our wood, if coal were discontinued. I might add, that owing to our geographical position, being nearly surrounded by water, thus exposing our woodland to the cold, freezing inclement winds of winter, a great amount of our standing timber is at present in a state of decay, and landowners are clearing off the wood on this account. Coal is our present fuel, and with present prices, will, in a short time, supplant wood.

Hillier.—Many years' supply.

WATERLOO.

Wilmott.—Many use coal to some extent; supply of wood, by careful management, sufficient for the present generation.

Wellesley.—Some coal used; perhaps sixty years' wood; 9,000 acres bush.

Waterloo.—Villages and many farmers using coal, one-fourth of the township being in bush and little clearing being done for farm purposes; with care, the young timber will supply the decrease.

WELLAND.

Willoughby.—Probably twenty years' supply.

Bertie.—One-sixth bush; perhaps thirty years' supply.

Crowland.—Twenty years' supply.

Stamford.—One-half use coal in winter; twenty years' supply.

Wainfleet.—No coal used; fifteen years' wood.

WELLINGTON.

West Garafraxa.—Little coal used ; fifteen years' wood.

West Luther.—No coal used ; forty years' wood.

Guelph.—Coal partly used ; twenty years' wood.

Puslinch.—With careful husbandry, and barring accident by fire and tempest, twenty-five years' supply.

Nichol.—Some coal used ; twelve years' wood.

Arthur.—Little coal used ; perhaps twenty years' wood.

Maryburgh.—Coal somewhat used ; forty years' wood.

Eramosa.—Thirty-five years supply.

Pilkington.—Coal much used ; most farms have six to ten years' firewood.

Minto.—The farms here are nearly all cleared ; firewood obtained with difficulty ; coal must soon be extensively used.

Erin.—Coal little used ; twenty years' wood.

WENTWORTH.

North Glanford.—2,063 acres of wood returned ; but, I think, that although that number of acres may still be termed timber land, there is not more than one-third or one-half at most, of the amount of timber that originally stood upon the ground, it having been constantly, for years, thinned out for fuel and other purposes. As to coal, it is being pretty generally used in winter for heating purposes.

East Flamborough.—Much coal used ; thirty years' wood.

Ancaster.—Coal considerably used ; the supply of firewood is fast diminishing ; and without more care and economy is used in the future, will be exhausted by the next generation.

Beverly.—Hard coal somewhat used ; if the wood in the township be well cared for, the annual growth will supply the farms.

YORK.

Etobicoke.—Much coal used ; twenty years' wood.

Vaughan.—Coal largely used ; nine years' wood.

Markham.—Coal much used ; twenty-five years' wood, or more.

East Gwillimbury.—Coal largely used ; twenty-five years' wood.

Whitchurch.—Coal considerably used ; twenty years' wood.

In noticing these opinions, which are of the greatest importance, one point must be carefully remembered ; that is, that many state the position of the fuel supply in their townships to be such that, with care, they would have wood enough for many years. This is undoubtedly the case. With care to keep cattle out, as remarked, our forest patches would be continually reproductive ; or, which is the same thing, if the cattle be never let in, except when the pasture outside is good. When the pasture is good they will not do the forest much harm. But it cannot be too often impressed upon the minds of forest owners, that the only way to preserve a wood, is to allow a succession of young trees to grow up ; and that if cattle be let in hungry, they will nip the supply in the shoot. A piece of woods, twenty-five acres, owned by the Snell Brothers, the well-known cattle breeders, of Edmonton, furnishes a good instance of this. Here may be seen in full and apposite view—I quote a former description—the difference between the sapling of the forest and the sapling of the field. Here is no longer the maple, no longer the ash of the roadside—stout, many-branched and square of stature. Here, beneath the tall and embowering branches, rises the young maple, scarcely more than eight inches at the base, shooting upwards in sheer and twigless pillar ; dark gray, of mottled skin, seventy feet of height, or more, till its topmost twigs may burgeon into head, whence sun and air may feed the trunk below. Here is the beech, almost equally tall, slim and branchless, pressing upwards, instinctively aware that its life depends on attaining the sunlight

above. Here is the yellow birch, scarce three inches through, forty-feet in height, destitute at this season of foliage on its few and scanty projecting limbs, and appearing, where a streak of sunlight falls upon its polished trunk, like a slender and rounded pillar of shimmering and dusty silver. All round, everywhere down the forest glades, visible from our carriage, rises many another youthful tree—the elm, the ash, the oak—lofty and beautiful; six-inch stems, every one: all emulously pressing to the light and life above. Every here and there stand the huge and older trees, but sparsely scattered; for this twenty-five acres has, for this score of years, yielded annually its thirty cords of wood to stove and fire-place, and will probably continue to yield as much, as the process of re-production is being continued in full vigor, and the forest earth is dotted with little seedlings springing up, ready to be trees in turn. This piece of woods affords a good example of the manner in which the forest can be preserved, if care be taken. There are two ways of preventing cattle from destroying the forest; one is to fence them out; the other to keep their pastures rich. Cattle have always had free access to this piece of woods; but the adjoining fields, where they pasture, have always been kept in heavy grass, the cattle never being allowed on the pastures in spring until a rich growth has appeared. The consequence has been that the cattle have gone through the bush when they chose, without any inclination to feed on the young trees. It will be observed that patches of wood so kept are not so liable to suffer loss from wind; the trees originally left at the edge, their trunks weakened by the force of a sun, to which they were unused, would fall; but these could, either before or after being blown down, be removed and used for firewood. The young trees springing round the borders, and growing up exposed to the sun, acquire the form of the low and many-branched trees of the open plain, giving a border which will not itself blow down, and acts as protection against sun and wind, to the older trees behind it. But we must remember, that if cattle anxious for food, had been permitted entrance, they would have destroyed the young surrounding trees in their infancy.

But what my informants generally have in their remembrance, is the manner in which the forest has, of late years, disappeared. It may be trusted that better care will be taken in future; but to state the reasons why it should be taken, let us mention some of the evils to be feared if our wonted course were longer persisted in. We will now suppose that no new plantations are grown and that the firewood is exhausted. Let us calculate the amount this proportion of Ontario will have to pay yearly for coal. We may, not unfairly, take it that these townships will have average 350 farmers, needing at least ten tons of coal yearly, which, at eight dollars per ton, would be \$5,600,000. It could by no means be carried for less than that price; and this allowance of fuel is so moderate that, considering the number who would use much more, the total sum could not be less than \$8,000,000 yearly. As these townships will not give more than two-thirds of the growing capacity of Ontario, this would almost equal the whole amount of agricultural products, exclusive of cattle, exported by that part of Ontario. It is plain that so great a proportion of our farm products could never be made up by bringing into cultivation the portion now in forest on each farm. There must be very serious loss suffered, look at it how you will, when the supply of firewood is exhausted in, say, very probably (considering clearing for farm purposes, which always goes on whether intended or not, for woods uncared for and left free to cattle, get to be such an eyesore that they are cut down and the land cropped), twenty years. The account then stands, that in twenty years most of the Ontario farms must pay a rent of from \$100 to \$150 a year for fuel, having as a set-off whatever additional crops they can raise in consequence of completely clearing the land. Those who do not then have to pay this, in consequence of having wood still on hand, will have paid its equivalent in buying coal for partially or fully supplying their fuel from now till then. That is, taking an average; for though many will have plenty then, yet that will be balanced by those who have none even now. But next, it is an important matter that they will certainly not get this set-off of the increased production of crops consequent on full clearing, for, if there is anything well proved by repeated testimony in America, it is that when the woods are nearly or quite gone, the farms do not yield the good return to the husbandman as when such remained in forest. It cannot be too impressively stated that this is not due to the exhaustion of the land by over-

cropping, for neither will bush land yield nearly as well when first cropped as did its adjoining bush land at the former period. It will come to this, then, on a rough but pretty just calculation, that in about twenty years the farms of Ontario must pay \$100 to \$150 each, yearly, for fuel; this not being repaid them by the additional land under cultivation, as experience shows that their crops will be at least so much the less remunerative when the forests are gone.

It seems to me that in this condition of affairs there is but one source for the provident farmer, who wishes his farm to retain its value, to pursue—that is, he should plant a strip of timber, choosing, of course, the most exposed aspect of his farm, and thereby obtaining at once shelter and certainty of future fuel. Such strips should be a hundred feet deep at least. People who have only seen the natural forest, and often only that when it has been thinned by many successive cullings, have very little idea of the quantity of wood which a small portion of land properly planted and given ordinary care, can be made to yield; that is to say, when the trees are placed at about four feet apart each way.

They will then grow to trunk instead of branches; and the same ground, which one tree grown in the open would have occupied with its spreading limbs, might give, in some cases, as many as forty or fifty tall, straight stems, say eight feet apart, after thinning once. After some time, half of these could again be taken, and wood, easily worked and split, procured all the while. Open planting gives trees full of knots; the close planting gives clear timber. It may be understood by this how very different is the return obtainable from ordinary bush land to that which might be expected from a regularly managed plantation. I would like, did space permit, to give my readers some idea of how this is done in Europe, where a forest is reproduced in rotation, an acre being planted for every acre cut; and the trees standing at even distances, as regularly as vegetables in a garden.

As soon as our land-owners actually realize the description of what may be called a wood famine, which must soon overspread America, when the process of culling which now exists has exhausted the areas of valuable woods, planting will commence in all directions. Within a few years, those who are provident and far-seeing enough to commence at once will see buyers approaching their doors, with, "What will you take for so many of those second-growth elms?" or "I would like to purchase a good many white ash from you; I see you have some hundreds there." Those who have grown hickory will be able to get a price for it which will put them forever "out of conceit" with wheat growing. They will find, if judiciously planted and cared for, the wood lot yields more dollars per each acre than any five on their farm.

It appears to me that, though undoubtedly progress is being made, and hundreds now plant trees and care for wood lots who would not have done so but for the efforts made to spread information on the subject, yet this progress will be probably so slow that the twenty years will pass and the evil will be on us before we have replaced or conserved by even one-tenth the amount necessary. What is needed is some general movement by the leaders of the community, and I will suggest one.

If you speak to a farmer who has tried planting forest trees to any considerable extent, he will tell you that though young trees of all descriptions are obtainable in the forest, yet practically, when sought for, it is difficult to find the class most suitable to plant. The forest sapling is generally inclined to spread its roots in a manner which renders it difficult of success in planting, or to send down one long tap root, often very hard to manage. Of course they are often planted out, but with the exception of the maple, an easy tree to move, there is frequently much trouble and many failures. They do not give the decided yearly growth of a transplanted seedling, for the reason that their roots are not such as to adapt themselves at once to the change. The nursery tree is, or should be, twice transplanted when small. Each change gives a greater number of healthy fibres to the roots; and by the time it is planted out ultimately, in its destined position, it should possess a considerable number of root fibres, full of life, which immediately take hold of the soil, and draw such nourishment from it that rapid growth is generally the result. There are many means, too, used with certain kinds of saplings, to improve the roots, and root pruning. The last, by the way, as I have pointed out to my

readers, is possible in the woods. But in a nursery, where you have a large expanse of easily worked earth, and situated, which is a very important matter, in a part of the country fit for the operations you contemplate, the raising of immense numbers of young trees in excellent condition for transferring to other localities is, with proper assistance, so easy a matter as to render it inadvisable to use forest grown trees. What I would suggest, as the only plan likely to give us plantations of forest trees throughout the country in time to meet the scarcity of fuel and timber, which, as shown, is rapidly approaching, is that sufficient appropriation be made to maintain public nurseries, either by the counties where they are most needed, or by the Government, where large quantities of young trees might be grown and distributed free to those who would agree to grow plantations of larger or smaller size. This would not interfere with any nursery business (though even in that case the few must give way to the many); but it could not, for very few plantations are attempted, the trees being generally placed in rows, which will yield shelter, but never a quick, tall growth of timber. They will give the hard, knotty, "second growth," valuable for much, but not for the purposes spoken of here. Let the professional men sell for the purposes they at present provide for; but this other, the great necessity, will not be met without extraordinary aid be given. It is just, too, that the farmers be aided to replant, for the cities have shared in the spoils of the land which has been cleared, and should assist in its partial re-forestation. I have reason to believe, from many assurances, that if such were grown and distributed, they would be, by very many, gladly received and cared for. It is easy, no doubt, to make objections to this plan, but it should be remembered that no other has been found capable of trial. Time goes on, and if no general move be made the country will suffer much. With so many farming competitors we should look to the sources of fertility, and above all, to the great one of tree preservation, the real need of Ontario.

CHAPTER II.

FORESTRY EXAMINATION OF TWO TOWNSHIPS.

NOTES FROM MARKHAM.

Two townships in Ontario, St. Vincent and Markham, have been selected this year for thorough forestry examination, as they were respectively on the northern and southern borders of the Ontario peninsula—the first close to the Georgian bay, the second rather removed from Lake Ontario, but still within its influence. These townships were completely traversed, every concession and side line being visited, and the opinions of all farmers, as far as possible, secured. What was noticed in Markham was that all agreed fall wheat was much benefited by the shelter of trees, and many stated that it was useless to attempt growing it without shelter. All agreed that grass was benefited by shelter, on any side. Some, but very few, objected to the shade thrown to the north by lines of trees. All, as a rule, thought more tree planting was very necessary. Wherever farmers were well read on the subject, and able to plant, they were establishing rows of trees round their farms. It was noticeable that many held the view that a wind-break on the south was as valuable as one on the north. Nearly all agreed that the rainfall was much more variable and distributed in a manner less useful to the farmer than when larger forests existed throughout the land. The general impression left was that Markham, having many farmers possessed of means, would soon have nearly every farm partially surrounded by trees, and that plantations of larger extent might shortly be looked for. Following will be found a great number of opinions from various farmers, all, or nearly all, it may

be noticed, freeholders ; from these, if my readers will go carefully over them, much may be learned :—

J. BRUMWELL has a bordering bush of poplars to the east which much benefits crops near. East and west wind-breaks would cast some injurious shade to the north. From north to south not at all. A number thus across the country would be a great advantage.

J. FARR—Wind-breaks would be valuable ; would prefer elms as easier to plough near. Of resinous trees cedars are most friendly to the soil. For dry land they should be taken from dry land.

Mr. JAMES has two fields protected on the north and east by a second growth of young pines, about thirty-five or forty feet high. These two fields have had excellent crops of fall wheat twice in succession, while the wheat over all the rest of the farm has not been nearly so good, and this, notwithstanding that these two fields have never been undrained, while the rest is well under-drained. Mr. James considers that, though draining is undoubtedly good, yet shelter from trees is better for fall wheat. Even right over the under-drains the wheat often failed, but succeeded with the exception of very small patches, where the bush gave shelter. Mr. James has also a long stretch of young pine wind-break in front of his farm. He finds no injury whatever from the pines near the crops. Would prefer spruce, as it spreads its branches near the ground and thus gives more shelter than pine, which have their branches some height up.

Mr. DUNCAN—Bush on the north and west makes his fall wheat and grass much better there. A double row of spruce twenty feet high makes grass much better and heavier that side of the field and a good way across.

Mr. MARSH has bush on the north side. No difference in the spring crops, but so much in fall that wind-breaks would have saved nineteen-twentieths of his crop last year, which was so badly winter-killed where unprotected as to necessitate ploughing up nearly the whole.

Mr. CICELY finds that the crops are helped by shelter both fall and spring. Has noticed that the grass, where sheltered to the north by a row of buildings, is much better and taller. Has lately planted some hundreds of young cedars three feet high, and though taken from a wet swamp, they have all done well. Is so convinced of the value of wind-breaks that he is about to plant a row along the whole north and west of his farm.

Mr. LYNETT has bush on the north and east. Fall wheat is always a surer crop there. The present small portions of bush in various parts of the township cannot give much protection, but lengthy rows of trees would be of great value.

Mr. JACQUES, on the celebrated Rennie farm, is strongly of opinion that the presence of woods benefits crops, especially fall wheat, but the others largely by the influence of the moisture in the ground which decreases as the woods are cut. Intends himself to finish out the tree planting in lines on his farm, and preserve all the bush now on it carefully, only using fallen trees for fuel.

OLD MILLER HOMESTEAD—Here is one of the finest wind-breaks in Ontario, a double row of pines planted thirty-five years ago, forty feet high, and three rows of spruce all ten feet apart (the pines to the outside) planted twenty-three years, and now taller than the pine. This surrounds an orchard of about two acres. The clover in the orchard is a heavy crop and grows as thick close up to the trees as elsewhere. The fields to the north and west show no injury whatever from shade, the grass growing as well close up. Mr. Miller, as son of the late proprietor, says : It is of the greatest possible service to the farm. Mr. Miller has planted wind-breaks at his own farm a mile off and would not be without them for thousands of dollars. Would pay that difference if buying a farm. When he went on his place could not grow anything with ease for the wind, which blew his young rose trees to pieces. Has it now well sheltered. Gave the statement that all fall wheat near not sheltered largely failed. Where sheltered on any side, it was a good crop. Fields near here, not sheltered, of ten acres, lost four out of the ten. Would not object to anyone planting a wind-break south of his land ; considers the benefit of checking the

force of the wind much greater than the trifling loss by shade. Would be glad to see farmers induced to plant long lines of trees; if done generally it would be the best thing possible for the country.

Mr. MILLER (a namesake) has planted a fine row of pines round his grounds and found them of the greatest possible benefit. These were planted the first new moon in June, which was considered the best time. Cedar he finds succeed well and grow large and fine wind-breaks. Is planting a field, three acres, with maples as a grove. He will fill some of the field, being low, with soft maple and cedar. Agriculture will be almost impossible here unless more trees are planted to check the wind. Believes from his experience that if much of the land were in trees the rest would grow more than now when it is mostly cleared. Has planted a great deal on his place.

Mr. HOOVER—Shelter does not benefit spring crops so much, but winter crops are much the better for it. Sheltered fields have always much the best fall wheat.

Mr. LOWRY has two fields sheltered by woods on the north and partially on the west. These fields he can always depend upon for a crop of wheat. It will grow there with poor culture better than elsewhere with good. One end is exposed and there the north-west wind always kills the fall wheat. All along the rest the wheat keeps good for about forty rods from the woods, when it begins to winter-kill. Mr. Lowry believes that spring crops also are much benefited by shelter of wind-breaks or woods, which he considers keep the moisture in the land after rains. He has planted spruce wind-breaks round his orchard and means to continue it round his farm. Last year all fall wheat in the neighbourhood failed except where sheltered.

Mr. CASTOR intends to plant a wind-break along the exposed side of his farm. Shelter is the great necessity for enabling crops to be profitably grown in Ontario. The north and north-west winds, which blow the snow off the fields, are one great cause of the repeated bad crops of fall wheat.

Mr. HAMILTON—The shelter of woods is of such benefit to all winter crops that as the woods go, wind-breaks must be planted. He has planted a row along one whole side of his farm this spring, using maples.

Mr. RAYNER—Shelter is of great value to fall wheat.

Mr. KLINK—The great trouble in growing fall wheat now is that in April a cold wind comes along and does it harm. Did not notice any difference in spring crops. The shade on the north of a bush would weaken crops for a short distance, but the shelter on the south would assist them over a much wider space. Cedar will grow fast and tall here, and make a much better wind-break than spruce.

Mr. GANTON—Though fall wheat is our most valuable crop, yet it would almost be as well to give it up if no better chance arrives; has tried it three times with little success. Shelter is valuable for it; would be glad to see some means tried to afford it; even for the sake of the roads it would be an excellent thing to try the experiment of wind-breaks, as in winter it is freezing work to travel much now. With wind-breaks travel would be infinitely more comfortable. Has planted cedar on the north, but it failed—will try again.

Mr. WIDEMAN would be glad to see some law which should induce farmers to plant a certain number of trees yearly. A wood benefits fall wheat to a considerable distance; much more than forty rods.

Mr. PALMER—If we are to continue to grow fall wheat, the shelter of trees must be encouraged. Has not known a sheltered field to fail lately with this crop, while in the open failures were common; had this year to plough up twenty acres. A good line of second growth evergreens will give shelter over a wide field. For shade for cattle, too, trees should be preserved. Grass was much better where sheltered by trees. In a field near with rows of young trees along the sides it grew as fast again.

Mr. RUSSELL—Lines of trees would weaken the crop north of them for twenty feet. If fall wheat is to be grown, however, shelter is necessary. His son this year had the best crop in the township, in a field sheltered on the north and west. In fields without

shelter the percentage of crop lost was large. Has not had a stick cut on the farm for twenty-five years except for fuel, thereby saving an excellent bush. The shade of trees is very good also for cattle. Is decidedly in favour of preserving a proper amount of trees. A great trouble in the way of planting wind-breaks is the expense, labour being now so dear.

Mr. LANGSTAFF—Shelter is valuable for fall wheat in especial and to a certain extent to grass. In Essa the only fields to be relied upon for fall wheat were those next the bush. The effect of shelter would be very evident half way across a twelve acre field and would benefit the whole field more or less. This was the case throughout Essa.

Mr. RICEBOROUGH's farm is almost entirely without shelter, although his crops, especially spring crops, are always up to the average. On one field, protected on the west by rows of pines and cedar, his fall wheat was good in seasons when it was killed in the other portions of the field. The soil is clay loam. He has planted a considerable number of trees and would be willing to plant more, especially if the cost of procuring suitable trees were diminished. Has intended for some time to protect the north side of his farm with trees. Is in general in favour of more extensive shelter being provided from the north and west winds, especially for fall wheat. Regrets the neglect he has noticed in the matter of planting timber.

Mr. NOBLE has noticed that his crops are almost always better preserved when they are sheltered by woods remaining on the west. His land has been long cleared. Is strongly of opinion that even wind-breaks would be beneficial in the way of drawing moisture, but does not think that if planted near roads they would have any material effect upon them, as the wind-breaks would not be wide enough. He prefers evergreens, especially Norway spruce, to any other kind of tree. Has had great trouble from cattle upon the roads destroying the trees. He has procured from Nebraska some seeds of the Box elder, a variety comparatively new to Ontario. Is greatly in favour of having lines of Norway spruce planted along the roads, as they would furnish shelter in winter and would also greatly increase the amount of produce. Intends planting along the north side of his farm, which borders on the road, a wind-break consisting of two rows of maples and a row of spruce in the centre. Mr. Noble is willing to expend on tree-planting and is satisfied that his investment will be repaid by the ornament as well as the profit derived.

Mr. ROBERT CANNING believes that evergreens are less injurious in their immediate vicinity to crops than deciduous trees. Finds the protection afforded by shelter on the north-west advantageous. The evergreens are better than maples—for example, because they afford most shelter during the winter when the protection is most needed. Has planted a large number of spruce, mainly for shade and protection, with splendid success.

Mr. HUGH CANNING pointed out the case of one field of fall wheat, protected on the north and west by old woods, where the crop is not killed at all, while another field on the same farm not protected is badly damaged, to the extent of one-third, though the land is of the same quality, both fields drained and both sloping to the north. The country as it becomes more cleared will lose its moisture, the result being that it will not raise fall wheat so well. It is better to have the trees planted on the north and west of the farm irrespective of roads. Likes trees that grow up quickly and would prefer a mixture of evergreens, maples and elms for example. He has had good success with balsams taken from the swamp, which if well planted and cared for, he believes as good as any kind; also maples, a number of which he has planted.

Mr. MORRIS has known cases where the shelter made so much difference that he has better crops in sheltered parts where the soil is comparatively poor. As the woods disappear the climate will become much colder and the land will become dryer. Even the soft maples are becoming scarce for planting purposes.

Mr. McLEAN has some woods remaining as a shelter from the east and south which he regards as no disadvantage, and during some winters a positive advantage to fall wheat from the protection afforded by the coat of snow which could be collected, but in the case

of spring crops he considers that a wind-break on the south would hinder and delay sowing operations. In the case of protection to orchards they would be of great benefit, especially on the north and west. He would plant trees along every road side, as they will not affect the state of the roads materially. In his neighbourhood there is a fixed intention on the part of many to plant to a much larger extent than formerly. Would prefer evergreens in some localities and maples in others. He has planted a number of both kinds, spruce as shelter for fruit trees, while maples are ornamental in summer in places where protection in winter is not so urgent.

Mr. GRAHAM would plant trees on the road side rather than on the farms, but he would require that laws be enforced preventing cattle from being at large. Trees in the roads would be less bother to the farmer; it is the fact of so many cattle being at large upon the roads that has prevented him from planting. He is of opinion that if something in the way of protection by trees were provided fall wheat might yet be successfully grown in his neighbourhood. In his opinion spruce trees would be the most useful. He has cleared some bush off lately and it has had the effect of letting the wind to his neighbours timber, causing very great damage. He is strongly in favour of Government assistance in the way of procuring suitable trees that will branch out near the ground. Cedar suits certain soils only; the Norway spruce has been observed to do well wherever it has been planted. He is satisfied that there is not enough tree-planting being done. It requires encouragement on a more extensive scale.

Mr. ROBERT FRENCH believes that if he had wind-breaks planted on the north-west of his farm he would be able to grow fall wheat with more certainty of a good yield than at present. He has planted out a young orchard and will protect it on the west and north with spruce trees. He has been very unsuccessful with maples procured from the woods. He thinks that the injury to the roads by the trees planted along the road would be slight. Like the majority in his neighbourhood he favours spruce for planting, although soft maples are best for furnishing shade for cattle.

Mr. CROSBY—On low lands soft maples and elms and the native cedar are the best suited for hedges, and better than hard maples. It must be a good plan to plant trees both for ornament and protection, especially for winter crops. Would plant among fruit trees other varieties, such as walnut, butternut, etc. for protection. He is satisfied that the presence of trees on the streets of villages, etc. has the effect of making the atmosphere more healthy. Trees planted along the road can be trimmed up so as to remove any inconveniences from shade to the roads in spring time. There is no difficulty as yet in procuring trees, the native varieties, soft maple, etc., although there is not enough being done in the way of planting. If planted in the proper places the trees might afterwards be utilised as posts for stretching wires on.

Mr. HAGERMAN last year had a crop of fall wheat, part of which was protected by bush on the north. He found it necessary to plough up all the field except the small portion protected and believes that if it had all been protected his crop would have been saved. Trees planted along the roads running east and west would have a bad effect on mud roads. If genuine interest were created in the line of obtaining suitable trees and planting them as protection for exposed parts of the country it would have a highly beneficial effect, increasing the amount of produce as well as improving the general appearance of the country.

Mr. VINCENT JOHNSON—For the last two years whatever fall wheat was saved was in most cases due to the shelter of bush. Lines of evergreens would do but little harm by shading a small strip of land compared with the benefits obtained. He would raise more grain on his farm by allowing one rod along the north for the purpose of furnishing a wind-break. He prefers evergreens. Has had wheat protected on the north-west and noticed that it has been ripe earlier, and the grain has been plumper.

Mr. JONATHAN SLATER—Shelter from woods is beneficial, principally in the case fall wheat and grass, although the moisture that is in the soil adjacent to woods improves other crops as well. The protection from high winds is beneficial to crops at a distance of a quarter of a mile at least. The advantages of having trees planted on the roads

out balance any drawbacks that may occur. The disadvantage to the roads from trees planted on the south side would be greatest. Has thirty acres of bush remaining and has not found it necessary to plant, except for ornamental purposes. His woods are becoming thin; he is endeavouring to preserve them by keeping cattle out altogether. Government should interfere in the wholesale destruction of woods that is going on in the way of compelling those who cut away timber to plant other trees to replace it, a plan which is followed in some parts of Europe.

In Mr. GOHIE's neighbourhood good timber is becoming scarce. He would be in favour of some plan by which evergreens might be furnished to form wind-breaks.

Mr. LEEK has not planted any trees and does not believe that rows of evergreens would furnish a sufficient wind-break to be of any material benefit. They would also take the strength of the ground and stunt the crops in their immediate vicinity, though he admits that the bush he possesses, twenty or twenty-five acres, has in different cases preserved his fall wheat.

Mr. JOHN CLARK, Headford, considers the presence of trees an advantage to crops as well as a shelter to buildings, fences, etc. He has found them a benefit to crops of fall wheat. His own intention is to plant to protect his house and garden, which are built on an elevated spot, but would not go to any great expense in the way of planting systematically for shelter to crops.

Mr. SANDERSON—Cedar is as good as Norway spruce and it can be procured quite easily. Cedars are quite as good on high land as low when once they are started; he can point out cases of the cedars growing to the height of from 10 to 15 feet on high land.

Mr. FICHELDER's woods shelter fields from the north winds and protect his wheat in seasons when it is killed in other places. Has planted maples on the east front of his farm, some of which have been killed by cattle on the roads, also by vehicles being driven along the side of the road. If he had a wind-break planted along the north side of his farm it would be a great benefit to it. Has planted a number of walnuts in his woods with a view to profit from them in the future. A small number of pines were planted, but all died. Has planted spruce for a wind-break for the house and garden.

Mr. MILLER had fourteen acres of wheat sheltered on the north and west by woods on land sloping west, of which about six acres was saved by shelter from the bush. A considerable part of the woods was cedar. His land is rather low, heavy clay, and undrained, fifty rods of shelter on the north have been chopped off last year, rye sowed in this is rather a poor crop. He has planted cedars to a large extent (500 rods) on his farm which he intends to use afterwards as fences, though some of them have died. Some were planted close for a hedge, others four or five feet apart. He considers that cedars suit his land best—they are hardy and furnish shelter in winter, as it is only in winter that shelter is needed. In low, wet land they must be planted top of the ground with some soil thrown on the roots, otherwise they die; they grow slower than spruce.

Mr. F. ECHARDT has a fairly sheltered field which raises wheat every third year. Last year was the first time that a failure occurred and this on only about five acres on the least sheltered part. Another field (thirteen acres) south of it unprotected, was all ploughed up. In his lane, part of which has pine trees along it on north, it is always clear of snow when the rest of it is drifted. Regrets that he had not left a row of trees wherever he had a fence. Has a swamp lying to the east of his orchard which has been a protection, though he would rather have it to the west.

Mr. PRINGLE does not consider the protection of a swamp wood that he has on his place of any material benefit to the crops; it affords however a shelter from the west winds to his house and buildings. The path runs along the south edge of the swamp and in winter is protected from snow drifts.

Mr. WILLIAM LATIMER has no woods on his farm nor shelter from trees of any kind. He sowed six acres of wheat the last two years, and lost the crops from the effects of winter-killing. Two of his neighbours had wheat saved, but in every case it was sheltered

in some way. Another neighbour who has no bush has not sown fall wheat for the last two years on account of failure before. Is strongly in favour of tree-planting for ornament and shelter. He pointed out a short row of cedars closely planted along a fence sheltering a field of his which lay to the south; when he had wheat or grass on this field, about six or eight rods from the fence was good, the rest killed.

Mr. ALEX. PRINGLE has twenty acres of bush on the west side, and half of his farm is protected by a row of trees left running north and south to the south of his bush. Last year he had fifteen acres of fall wheat in the field lying to the east of this; seven and a-half acres nearest to the woods were a good crop, the other entirely killed. The effect of the woods extend over ten acres at least. The land is drained and slopes to the south. In his neighbourhood many are planting maples for protection to gardens, orchards, etc., from the north winds. Would prefer having the trees planted on the road. Has planted trees, but they have not reached a sufficient height to be of benefit to crops. The benefit of shelter is confined to fall crops.

Mr. SUMMERFELDS has examples of fields sheltered on every side. One small field is in fall wheat, protected on the south-east. It is not killed out, but the land is new, low and swampy, which has kept it backward. Most of his land that lies between the bush is pasture, and grows good pasture.

Mr. C. HOUCK has twenty acres of woods sheltering the east side. He cannot see any benefit that is derived from woods on that side. He sows fall wheat seven or eight acres each year. Occasionally it is good. He points out a case where shelter was a benefit on the north, a field of a neighbor so sheltered being the only piece of wheat remaining last year.

Mr. NIGH has protection on the west from old woods. A couple of acres farthest away from the woods has been killed in fall wheat, the other eight acres remaining. He has planted 125 spruce trees, all living, to form a protection to buildings. He would prefer evergreens, especially Norway spruce.

Mr. JOHN BRUCE gives an instance of a farm sheltered by a belt of trees about one-eighth of a mile wide and over a quarter of a mile long, sheltering fields on the south, and never in any case has he seen the fall wheat fail when so sheltered. He has often noticed that a shower divides when there happens to be a clearing of any extent, each part following the wooded country. Trees are valuable as conductors between the atmosphere and the earth, and tend to preserve the moisture; the effect of clearing too extensively is to produce sterility and drought. His brother bought a farm to the north of him in order that it might not fall into other hands, and the timber be cleared off. He does not believe that coal will ever take the place of wood for fuel.

Mr. BURTON's farm lies facing the east, with the town line along the north. He has thirty acres of bush on the west, and the benefits of which he has found to be so great that he has commenced planting a wind-break of maples and spruce along the north side. He believes that cedars could be planted out at a small expense. They would grow to a sufficient height to make a good wind-break. Basswoods are not injurious to the land; he has one here and there scattered through his fields, and will preserve them by all means as shade for his sheep and cattle. He is satisfied that anything in the way of planting must be done on a thorough plan, not in patchwork as formerly. A solid cedar hedge, backed by woods, has grown so high along the line to the east of his farm that they begin to affect the roads, but he would strongly object to having them cut down, and would only trim them to the proper height. It is only for a short time that the roads are kept damp in the spring. In his orchard, which has until just lately been entirely unprotected, many of the fruit trees have been destroyed by frost. The frost split the bark and ruined the trees. Also wherever the blossoms have been protected in May the fruit crop has been good, a slight frost at this time of the year having ruined the prospects in the case of unprotected trees. He prefers planting the trees on his own premises as close to the line as possible, with the view of forming fences when large enough.

Mr. RAYMER believes in cutting out the big timber and leaving the smaller. He thinks this is the best way to protect. The people are themselves to blame for slashing out all the timber.

Mr. MARTIN WIDEMAN has about twenty acres of bush on the west ; wheat sown beside it was killed on the side farthest from the bush, one-quarter at least, and even then he believes the bush saved it to some extent. Bush on the south he considers a disadvantage ; he would rather have it away.

Mr. REESOR lost six acres of wheat which was not sheltered. Would be willing to plant trees if any laws to that effect were passed.

Mr. C. B. HOOVER—The grain is always plump wherever it has a tree, whether orchard or a single tree, in the middle of the field. Has observed instances where shelter saved fall wheat, while all exposed near was killed.

Mr. JOHN WILLIAMS has a row of spruce along the north of his buildings perhaps ten rods long, planted about twenty years ago. They form an admirable wind-break for the buildings.

Mr. HOOVER has forty rods of spruce, twelve years old, along the west side of his orchard, about twenty feet high. They form a protection when the fruit is nearly ripe. On the east side of the orchard there are woods which shelter it from the east wind. Five or six feet from the spruce wind-break the grain does not do so well. They don't branch out far enough yet to do great injury. He considered them especially beneficial to buildings and fruit trees, but not so much to crops.

Mr. T. WILLIAMS has a wind-break by about sixty rods long, consisting of spruce and cedar about twenty feet high, which he considers worth a thousand dollars to his farm. It runs along the north side of his orchard, and invariably protects the fruits, when in no better orchards it is destroyed. He considers spruce trees the best, and next to them, cedar. He is preparing to plant spruce along the north and west of his farm. He will have nothing but wire fences in order to get on the land ten days earlier in spring. The trees did not keep the land wet in spring because the snow was of even depth. He can work the land on the north of his wind-break as early as anywhere, while on the south it is always much earlier. His opinion is that the Government should provide trees free to anyone that will plant them. Unless trees are planted for shelter there will be no use in sowing fall wheat.

Mr. MILNE has ten acres of fall wheat on clay land, protected on the north by a bush ; of fall wheat and maple ; about five or six acres near the bush is a good crop ; in the rest fully half is killed out. He attributes the difference entirely to the shelter of the trees.

Mr. ROLPH has noticed the general benefit to fall wheat wherever it has been sheltered on the north and west. In a field of his which has woods to the east he considers that the shelter has in many cases been an injury. The field was drained, but the woods kept the snow on so long that the wheat was weakened. In the case of spring crops, the field near the woods seemed always inclined to rust. Evergreens are the best shade if raising fall wheat is the object, or for meadows.

Mr. WOOD rents his farm, and considers that any investment in tree-planting would return no profit unless leases were extended to a much larger period than at present. He prefers evergreens, when properly trimmed, to maples.

Mr. GEORGE ROBB has planted a row of spruce about twenty rods long on the north and west of one set of buildings. Planted about twelve years, now average twenty feet in height. He finds great benefit from the shelter from the orchard, especially from the frost ; the bark does not split from the effects of cold weather. Along the east side of the farm there is old woods extending about eighty rods, also on the north about the same. The east wind is kept off, but the east shelter is no great benefit. He believes that the clearing has had the effect of injury to the land, nor have we now the same showers as formerly. Evergreens, especially spruce, are preferable. He has planted 160 rods of maples.

Mr. JOHN YOUNG, for the last two years, has sown ten acres of wheat unprotected by trees, and had to plough it up in both cases. His land is all drained. He has noticed that as a rule the fall wheat has been better when sheltered by woods.

Mr. ROBERT CUNNINGHAM has three acres of woods forming a shelter on the north-west. The field (14 acres) next to it had fall wheat on last year, and it was all ploughed up except about two acres sheltered by the woods. He attributes the difference entirely to the shelter. The field sloped to the east; it was so high that it did not require draining. Wind-breaks on the north are beneficial for the crops. He intends planting all along the road maples two rods apart. If planting on his own land, along the roads at least, he prefers the white ash to evergreen, but for a wind-break the evergreens are the best.

Mr. SMITH has noticed the general benefit to fall wheat from shelter on the north and west. He considers that lines of evergreens would take up too much land to be of any material benefit to the crops, that is, if they are thick enough to become a wind-break.

Mr. HOGG considers that land gets dryer and poorer the longer it is cleared. This is to be accounted for mainly by the removal of the woods. Norway spruce would give the best shelter, and would grow best on his land, sandy loam. He does not think that the trees would injure the roads.

Mr. THOS. BROWN has seen fields of wheat totally destroyed where there was no shelter, when in cases where there was wood the crop was saved. Where the land is drained it will do better without shelter than land that is not. Wind-breaks will make land comparatively valueless for grain as far on the north of them as the shadows are cast at midday. Evergreens would do best, as the shelter is needed in the latter part of April or the beginning of May, often the most trying time to fall wheat.

Mr. JOHN TRUDGEON has ploughed up his wheat for the past two years; unsheltered. He believes that the land as it becomes more clear retains less moisture. Wind-breaks along the road would do no injury, but he would plant them along the north and west to be of benefit to crops.

Mr. ISAAC BRUMMELL—This spring sheltered wheat is comparatively good; where it is exposed it is killed. He has no winter wheat. He has seen in a cold spring that spring grain sheltered does better. He has not planted trees as shelter, but considers that he could select trees that, if planted along the north of his farm as wind-breaks, would repay the cost of the ground taken up. He would prefer evergreens because they afford a shelter at every season of the year.

Mr. WILLIAM LEWIS—An orchard stands in the north-west corner of a field, and every time he sows fall wheat in this field he is sure of a crop, and the wheat fails in other places. No difference in the draining or slope, though if anything, other places of the farm have the advantage in the way of rolling land. For general benefit he is in favour of tree planting. He believes that any loss of land that is taken up by a wind-break would be made up by increase in the crop on the rest of the farm. He would prefer to see them planted in a zig-zag manner. Evergreens are preferable.

Mr. STOUTENBURGH says that he found the benefit of a bush one and a-half miles long along the north of his farm with a road between. He never had a failure on any part of his farm in fall wheat while this remained. His wheat as a general thing is damaged since this was cleared up. He has a bush on the south of him; it is no advantage, though not an injury. His land is pretty much drained. His orchard shelters his crop to the extent of fifty rods in fall wheat; other grain needs no shelter. Is strongly in favour of some plan by which lines of trees might be planted out through the country. Has seen the showers fall on the ridges and where the woods are. Nursery trees will grow much quicker and surer than trees got in the woods. Pine trees (half a dozen, fifty feet high) on the north side shelter the wheat twenty rods in a streak. A wind-break running east and west will be no injury whatever to the farm north of it.

Mr. JENNINGS has planted eighty rods of maples on the inside of the fence. He has tried Manitoba maples, but they grow too much from the roots in the way of suckers. Prefers tamarac, cedars and balsam mixed. Cedars twenty-five years planted have been thinned off several times. They are large enough now for posts. Would plant rows of trees mentioned above along the north line; they would form a wind-break, but they

would take some nourishment. The crops, however, that he has on the north of a line of sumrac and cedars are as good as in other places. Trees should be selected that will afterwards form fuel in case they ever blow down, or if they should die. Cedars will grow on any kind of ground, high or low; has never lost a cedar that was properly planted. Any means by which trees might be furnished at less expense would be a great benefit to the country. Nursery trees are to be preferred to those taken from the woods. The ground must be prepared for planting any kind of trees so that the roots will have a chance to spread. Planted some hundreds of willows as a shelter for orchard and garden, most of which he has since cut down; found them a nuisance. The effect of the sun on the south of the wind-break impoverishes the land more than the shelter on the north. To form a wind-break he would plant two rows of trees.

Mr. MILLIKEN considers that what is needed is lines of trees across the country. He has on his lawn some fine specimens of Norway and native spruce. He has found the shelter of woods is very valuable for fall wheat, and, in fact, beneficial to crops generally. Is planting a line of Norway spruce and cedar along the whole north of his farm, having it in great part finished now. Planted at five feet from the fence, but considers that he planted it too close, as the branches soon need more room. Has about twice too many trees in it, which will give him every second tree to take up and replant. Believes that if a number of farmers would plant rows, the benefit would be very great. Has a row of pine about thirty feet high. The benefit from these would extend nearly across a square ten-acre field. Finds the second week in June a very good time to plant evergreens. A young spruce brought by him from New Brunswick (native there) seems of a better foliage than either the Norway or Canadian. Considers that shelter from the south-west side is also often serviceable, especially in preserving apples from the strong fall winds which are apt to blow them down.

Mr. HOOD—Shelter is very necessary, not only to fall wheat but to spring crops. Has grass, where sheltered by a line of trees, a foot higher than where it is not, and in a field of about seventeen acres, largely in clover, and having the shelter of a wood on the north and west, where the shelter exists the clover is very high and rich, while elsewhere it is very poor.

Mr. REESOR, Sen., states that shelter is always valuable to both spring and fall crops. Where the shade of the trees extends there will be some diminution in the crops, but nothing compared to the gain derived by the rest of the field. He and his family have planted very largely, being convinced of the benefit of wind-breaks. Is of opinion that the roads are excellent places to plant on, as it shades the crop less, while the shade does not to any great extent injure the roads. Pointed out a considerable length of road so shaded which was but little if any injured, while, on the other hand, the shade was very pleasant of a warm day. A field close by on the Reesor property, sheltered on the east by forest and on the west by a row of young maples, has now one of the best fall wheat crops in the township—a dense mass of wheat ears extending from fence to fence.

Mr. COLIN REESOR—Shelter is almost indispensable in many seasons for fall wheat. He had thirteen acres last year exposed on the north and west, which was completely killed out and had to be ploughed up, while a field near by, sheltered by woods on the north and an orchard on the west, had one of the best crops in the township. Trees on road do little or no harm to the road.

Mr. MILROY—The presence of trees as wind-breaks is of the greatest value to crops. Instanced two cases in which the portion of a crop of fall wheat, sheltered by a bush on the east, was saved, the rest a failure.

Mr. ROBERT REESOR—Shelter is what is needed for crops in this township. The Norway spruce is by far the best tree for wind-breaks. The shade necessarily thrown on the north is of no consequence compared to the benefit to the field.

Mr. ABRAHAM STRICKLER—What injures the fall wheat principally of late is the sharp freezing winds which sweep across in April where there are no woods left to shelter the crops. Wherever shelter exists for crops can be looked for, where it does not, half a crop. With reference to spring crops they are not benefited so much by shelter,

except to protect them from spring frosts which often occur, and are greatly mitigated in their effects by shelter. Wind-breaks also make a difference in the atmosphere of four degrees. The best wind-break is cedar, which, if not the most ornamental, is the most lasting.

Mr. MUSTARD—To be of use the wind-break should be of evergreen and several trees in depth. Most damage is done in April, when warm weather occurs, and sharp frosty winds following. The sudden change seems to weaken the wheat, which appears dead or decayed. The only chance is the obtaining shelter by means of trees, which also would prevent the snow blowing off the fields, and thus causing winter-killing.

Mr. PIKE—The winter crops badly need shelter, the want of which has been undoubtedly the cause of its failures of late. For wind-breaks, cedar and spruce are equally good.

Mr. GROVE—Wherever fall wheat was not sheltered by woods of late, a poor crop was frequently the result. Believes also, from observation, that all bodies of trees draw rain in summer and are valuable thence.

NOTES FROM ST. VINCENT.

In St. Vincent, south of the great chain of northern lakes, the conditions are different. Here, fall wheat was not mentioned as needing such shelter, or being so much improved by it. In Markham, near Lake Ontario, freezing winds in March and April were complained of as destroying the fall wheat—these winds, it will be noticed, passing over vast stretches of land, much of it still snow covered. In St. Vincent, on the contrary, the north and north-east breezes passing over the Georgian Bay, seemed to be deprived of this destroying power, and though shelter is still to a certain extent valuable for fall wheat, it does not appear so indispensable as on the Ontario shore. On the other hand, in both townships, great benefit appears to be derived from the shelter of either forests or lines of trees so far as grass is concerned. In St. Vincent and the bordering township of Euphrasia, many fields were passed where the elms after clearing had sprung up all along the fences, and now formed a natural wind-break thirty or more feet in height. Where grass was grown so protected, without exception, it was good; the protecting trees generally doubling the grass crop. Throughout this northern township, the farmers interrogated, comprising the great bulk of the community, stated that close to the shade of wind-breaks or forests their crops were weakened, especially to the north of the lines of trees. But without exception they admitted, what was evidently the fact that their township was drying up by over-clearing, and a greater amount of tree-planting would be beneficial. St. Vincent, it may be remarked, occupies in great part an elevated situation on high mountain ranges and the loss of fertile soil through washing, owing to the mistaken clearing of the summits of the hills, is often evident. Finally, what is the sum of all the observations of both townships is this, that much encouragement, whether in the shape of bonuses for trees planted, or in the shape of the gift of numbers of young trees, of a class and quality better than the woods afford—must be given to induce a sufficient rapidity and generality in planting trees in Ontario.

JOHN B. FERGUSON, 1st line—Fall wheat is much the better of shelter near; spring wheat crops not so decidedly so. More trees would be beneficial in obtaining summer rain; showers follow the lake or wooden stretch of country along Beaver River. Since forestry has been written up, quite an impetus has been given to tree-planting. Evergreens are hard to grow here; maples easy. Thinks of planting a good deal of ash

Has some young ash trees from which every year falls much seed, producing so many young trees that they are ploughed up by hundreds in the fall. Cut one down lately and found the timber excellent. Would have planted much before now, but the short season has been too crowded with work.

Mr. NOBLE, 3rd line, has land sheltered, but cannot give its effect on fall wheat, as it does not succeed in his neighbourhood. With spring crops is of opinion that shelter gives the crop more lasting benefit from showers, as the ground does not dry out so fast. Maples do not succeed here so well as alone.

Mr. WHITE, 3rd line, has witnessed the effects of loss of forests in this region, in the decided diminution of the number of showers in summer and lessened fertility of the land.

Mr. TUCKER, 3rd line, has noticed scarcity of summer rain since the bush was cleared up. Wind-breaks on the north and west are the things needed here—the force of the wind being great. Has planted many evergreens, but a number of them failed. Has succeeded well with maples, with care, but others, who were not careful, lost every tree. We noticed that one of the best crops of spring wheat observed was growing here under shelter of the bush. It had once, however, he said, rusted there.

Mr. WHEATELY, 1st line, is much in favour of planting forest trees, but has been too hurried to do as much as he would wish. Measures must be taken to form wind-breaks, both on account of the force of the wind here and the inferior supply of summer rain, consequent on loss of forest, or the country here will lose much of its fertility.

Mr. HARTMAN, 1st line, has taken particular notice of the effect of the shelter of his bush on the grass near it, and find it twice as good a crop, but a little coarser grass than where unsheltered. The late writing up of forestry matters has had a good effect through much of the country. Has planted a good deal himself, and has a beautiful wind-break of the locust or Acacia twelve or fourteen feet high and 100 yards long, which he says is of such benefit already as to show its value if extended. Is about to plant a belt of ash and other trees, three rods wide, along most of the north of his farm. Will use basswood, if possible, for the sake of the bees.

Mr. MACKAY, 1st line—Grain grows much better on the south side of a line of trees; not so good on the north side; finds grass grows well on either side; would plant trees on the north side of a farm; would prefer evergreens on account of winter shelter. His apples blow off badly; intends planting trees all round his orchard.

Mr. CROOKSHANK, 1st line—If trees shade the grain too much it will not grow well; but would like to have a line of balsams along the north side of his farm.

Mr. MCKITTRICK, town line—Trees are a benefit to meadows, especially when on the north side. His peas were on the south side of a bush this year; finds they were better near the bush; has wheat growing with a bush on the south side; finds it very short for about twenty feet from the fence. Thinks maple the best tree to plant.

Mr. McCauslin, 1st line—The ground dries up much faster now after rain. The rain falls much heavier than it used to but not so frequently. Grass grows better where it is sheltered; grain grows as well, does not think it fills quite so well in the shade. Intends planting trees all around his farm, would prefer evergreens; thinks elms easier to grow. His fruit is blown off badly since the wind gets such a sweep at it.

Mr. CHRISTIE, 3rd line, finds that the winds have now so much sweep that wind-breaks are becoming absolutely necessary. He proposes trying the poplar, either Lombardy or silver, in a long line on two sides of his farm, with, if procurable, a line of evergreens in front, which would fill up the gaps below. Thinks planting one of our chief needs.

Mr. RICHMOND, 3rd line—Climate much altered since clearing the forests; new land will not now yield the same crops; the wind has a much greater sweep than formerly, and would approve of wind-breaks on the side most exposed, but finds that where woods are on the east side the crop is subject to rust.

Mr. FOSTER, 3rd line, is much in favour of planting wind-breaks. Since the forest is being cleared there is not at all the same amount of rain falling when needed in summer. Wind-breaks would be valuable as shade for cattle.

Mr. MONTGOMERY—The chief noticeable change in the climate is the blowing of the snow in winter. The use of wire fences has not, he thinks, greatly helped this.

Mr. LATIERNEY, 3rd line—Climate much drier in summer of late years. The planting of trees is an excellent thing, but finds it difficult to grow them on hard clay. Has tried mixing building sand without effect.

Mr. ALMAN, 3rd line—Much difficulty in growing trees on the hard land. Has bush on the west side; but thinks the wheat near it is apt to rust. Is not certain of the general benefit of wind-breaks to fields; would approve of one near his orchard, but has not yet had time to start it.

Mr. FERGUSON, 3rd line—Evergreens would be the best to plant for shelter, as it is in the winter they are needed. Clearing makes the climate drier.

Mr. JAMESON, 3rd line—Wind-breaks are the only method of replacing the shelter of the woods, which are now fast blowing down here.

Mr. LAMB, 3rd line—Winds very heavy and sharp since the woods are going; is in favour of lines of trees along the borders of farms.

Mr. CARNAHAN, 4th line, has some fine, tall rows of elms and maples along the road side: being large and spreading, these weaken the crops of cereals under them, and perhaps twelve feet beyond. They stand north and south. Has some rows of trees standing east and west, which do not at all injure the crops close to them. His farm, he finds, always possesses sufficient moisture in the land, with a fair season. Intends to grow grass crops on that part of the land under and affected by the shade trees, and considers the shade will be very valuable for cattle.

Mr. DOUGHERTY, 4th line—The planting of rows of trees is advisable as, if something is not done, the present forests blowing down so fast here will in twenty years leave the country quite bare. Finds the winds very severe on fruit trees especially. It is no use trying to grow fruit without shelter here.

Mr. ELFORD, 4th line, has some fine rows of elms, but too close to one another, and has just cut one out in consequence. The near forest preserves moisture in adjacent lands, but does not notice this effect from single rows of trees. Has a portion of land of small value for crops which, if planted with trees and left for cattle, there being a spring there, would be of great use. Many such exist in the country, which should be so treated as the best hope of the farmer will, in future, be stock.

Mr. CHARTERS, 4th line—A line of trees along the exposed east side of a farm would greatly benefit as shelter. Close to the bush on the north, crops are not injured, close to one on the south the shade injures. Mr. Charters has a long line of hedge bought as buckthorn, which proved not to be genuine, and though pretty, is not very valuable. He has, however, two trees of the genuine Canadian buckthorn, from the seed of which he will raise many young plants. These trees are eight feet high, with plenty of strong thorns. They will make an excellent hedge, and what is important, they will thrive well in high land:

Mr. CLARK, 4th line, is much in favour of tree preservation; means to plant a hill-side in front of his house with evergreens. Has a portion of pasture surrounded by bush on three sides and a hill on the other, and finds that there they can pasture cattle in April, the grass being a month in advance of that elsewhere. Two sides of this are not his bush, but he means to plant evergreens along the edge now so as to be secure if his neighbours should clear theirs up.

Mr. W. WHITELAW, 4th line—Shelter is needed on this line, the situation being high and bleak. Some arrangement should be made with telegraph and telephone companies to wire on one side of the roads, leaving the other side free to plant trees on so that they need not cut them in placing wires. The Township Council had adopted the tree planting act, and this would give an impetus.

Mr. YOUNG, 4th line, finds—his land lying in a slope downwards from the east to the bush—that crops close to the bush are softer. Shelter of some sort, however, will be needed as the woods go; they are going fast now.

Mr. LOBLAW, 4th line—Crops close under the shelter of a bush to the west are soft and slow to fill; to the east not so. Planting the trees in wind-breaks thirty feet apart, sufficient sun would strike though to prevent any injury from shading. Fears evergreens would not do on this elevated land, but maple, ash and basswood would do well. Fall wheat cannot be well grown here since the forests are largely cleared.

Mr. W. YOUNG, 4th line, is much in favour of preserving a supply of wood, and is growing ten acres of second growth with that view. If a farm were divided into ten acre fields, and sixteen or eighteen trees left along one side of each, they would be no detriment, but a benefit. The country is not nearly so healthy as when better forested; if the present woods go it will be much worse. Cattle on the roads will not prevent ash from growing. Has a row of fine trees of that description ten years old.

Mr. GUY, 4th line, has preserved several fine rows of trees, besides a large portion of forest, so that much of his farm is well sheltered. In consequence he has the finest grass crop noticed, being much of it full four times as heavy as great part of that seen elsewhere. His other crops are also good. The cutting down of so much forest and planting no trees is ruinous. Though a near bush or a near wind-break may hurt some wheat under its shelter, yet that damage is many times overpaid by the benefits to the rest of the farm. Is heartily with the tree planting movement.

Mr. JOHN PARKER, 4th line, finds as the bush goes the climate becomes much more disagreeable, cold winds in the winter and spring being frequent and injurious. Lives in a sheltered place and finds a different climate in leaving the vicinity. Preserving bush or planting shade trees is very valuable to the country.

Mr. HUNTER, 4th line, finds since clearing is general, say twenty years, the summer climate, so far as regards rainfall, is not nearly as favourable to farming—the rain being now variable—sometimes very wet, sometimes the opposite; also the wind is troublesome. As for lines of trees he does not like them near a crop, but thinks that thirty feet apart they might not injure; also does not like them near roads, which in this locality they keep damp; but believes that all through this country there are many portions of land which, if they had, after a crop or two had been taken off, been while yet fresh planted, or allowed to grow up in good undergrowth, such as elm, ash or maple, would have been by this time more valuable for their timber, than any crops they can now produce. These would then have aided in improving the climate.

Mr. THORNTON, 4th line, has a line of elms twenty feet high, west of his orchard, which is of great benefit to it, preventing fruit from shaking off with the wind particularly. It will be, he thinks, absolutely necessary to plant trees here. Maples and ash rather than elms, as they stand straighter, while elms get a bend with the wind.

Mr. ABERCROMBY, 4th line, finds the climate changed for the worse by clearing. Finds a bush to the west injures crops close to it. Considers it very important to have trees and shade for cattle, if for no other purpose. Has a line of trees he would not lose for a great deal.

Mr. PETIT, 4th line—Would be glad to see each side of the road planted with trees. It will not keep them damp if they are properly turnpiked, and would be of good to the country. Summer rains much fewer since the country was cleared.

Mr. KELLY, 4th line, considers that those portions of a farm otherwise of little value had better be planted, as undoubtedly we should provide for timber and shelter, but does not like lines of trees, as they seem to weaken the crop by some feet each side.

Mr. JERROD, town line, favours trees on roads, as if turnpiked they would be dry enough. Finds a loss on crops close to them, except grass, which is benefited.

Mr. LOUCK, 7th line, finds that the trees are valuable for grass, and would encourage them on roads and dividing lines.

Mr. BIRCHELL, 7th line—Though little fall wheat is grown here, Mr. Birchell, who has a piece of land with a hill to the east, trees to the north and west, never fails of a good crop, and has an excellent one there now. Last year's gave forty bushels to the acre. His orchard, which is sheltered by tall trees across the road, and well shaded by its own trees, has a very heavy crop of clover. Plum trees, he finds, do not do so well when twenty feet from a line of poplars sixty feet high; at thirty feet they do well.

Mr. CHAPPELL, 7th line, is planting out long lines of maples. He does not, however, consider them necessary generally, as he fancies the young undergrowth springing up along fences and elsewhere, if preserved, will be sufficient.

Messrs. LOUCK, 7th line—Trees by roads will do no harm to the roads if planted 30 feet apart. Evergreens would answer best for shelter, but little tried here yet. Ash, maple and elm grow well. There is an idea that elm trees draw the land, but from experience they do not believe it.

Mr. MATTHEWS, 7th line, is much in favour of planting trees along roadsides, as it both affords shelter in winter and shade in summer. Does not think it hurts the roads. Thinks that along fences, close to crops, they draw the land, rendering it poor for a rod or two in width.

Mr. STILL, 7th line—Difference in climate perceivable is less showers in summer and exposure to cutting winds in winter, since clearing is general. The effect of trees on an adjacent crop is to weaken grain for a short piece; on grass to benefit it. Trees by roads do not keep the roads from drying to any injurious extent.

Mr. COOK, 7th line, finds showers less since clearing, and wind very piercing. Trees by a grain crop weaken it under the trees, but is not able to say as to the general effect on fields. Close to woods rust is likely. Much more tree planting should be done.

Mr. GOOLD, 7th line, finds that close to forests or lines of trees there will be loss both of grass and grain, more immediately under the shade than elsewhere. Where the trees stand perpendicularly there is little loss. Would not, however, do without trees, as probably they have much to do with keeping moisture in the earth, and they certainly check winds. Would plant lines on the south side of roads and on all inferior land on each farm. The shade of the trees on the roads will do little harm, or none, compared with the benefit. On the north they shade land to an injurious extent.

Mr. SAUNDERS, 7th line, considers that while both woods and lines of trees weaken crops under their shade, they yet benefit much more by their presence. Would like to see the inferior land of each farm in trees.

Mr. ELLIS, 7th line, finds crops much poorer since the country is much cleared. Believes lines of trees would help; they weaken crops in their shade, but give a beneficial moisture to the whole field.

Mr. McKAY, 7th line, is much in favour of planting lines of trees; crops poorer since the country is cleared; climate much changed; less snow by half; springs not so favourable to vegetation. Thinks woods on a farm, though injurious to crops directly under their shade, very beneficial to the farm generally. Approves most of maples or evergreens.

Mr. MACKEY, 7th line, considers it the greatest mistake to clear up so much of this country. Has been settled here fifty years, since Mackenzie's rebellion. Has noticed often that when a stretch of country is cleared the country dries up, whereas the contrary is necessary; when the trees are gone rain is much more needed. Lines of trees should be planted everywhere possible, and all the waste places left in wood. On his own farm, leaves one-fourth in woods and does not clear the swamp. The great need is to keep the wind from drying out the land too fast, and trees are the only means of doing this.

Mr. BOYCE, gravel road, finds, since clearing, the wind dries the moisture from the ground much quicker. Has woods to the south and west, grows all crops well right up to them, and particularly good grass—last year his timothy there being nearly six feet high.

Mr. C. LEVINS, gravel road, finds the sweep of winds, since the forest is being cleared, such that wind-breaks along the west would be of great benefit.

Mr. JOHN LEVINS, gravel road, does not like lines of trees to the south, as they weaken vegetation under their shade, but on the west would like them. A road through a bush will be slow in drying on account of the trees each side, but second growth trees along a road (of which Mr. Levins has some fine long, tall rows), will not keep it damp at all, or have any injurious effect.

Mr. SAMUEL EAGLE, gravel road, finds the need of shelter very much in the matter of orchards. The wind from the south-west blows hard fall and spring, when the ground is soft, and shakes the roots in the ground till they are quite loose. Has tried stakes and braces, but finds them ineffective and sometimes injurious unless carefully padded. Found rows of trees along the road on the south side, thirty-five feet high, keeps the snow level and the roads passable. Where there was no trees the road was blocked. Finds balsams not reliable; if they grow, they sometimes die in twelve years. With reference to the better class of evergreens, such as Norway spruce, he thought farmers must be assisted to purchase them or the movement would be very slow, as they come high.

Mr. DAY, Bayview—Evergreens do not grow well on this high ground, maple, elm and ash being better. While agreeing that shelter is valuable, yet has noticed that wind is more likely to prevent the midge, which works in the shelter of fences and sometimes trees.

Mr. BAKER, 12th line, gravel road, is of opinion that the most valuable thing connected with lines of trees is that they give shade to cattle. Observes that there is no shade so good as that of the butternut, which seems to have the property of keeping away insects, so that the cattle beneath it are not so much annoyed with flies. Mr. Baker observes that it is not so much what a beast eats which will benefit him, unless he also gets some quiet, shady place to lie and digest it in. Is in favour of one line of trees along the exposed part of his farm, also of much waste land being planted. States that many farms along certain lines here are being wasted away every year, as the bush has been cleared that should have held the rain, which now carries away all the good earth, till many of them are abandoned.

Mr. SHUNK, 12th line, considers there should be planted lines of trees along roads here in all parts. Much more of it should be done. In trying the Norway spruce, has planted fifty this spring about two feet high. These have been mulched with manure and are doing well. Mr. Shunk says this is a great point; he had a lot of trees in another place, and they were at a standstill, neither grew nor stopped. He mulched them in this manner and they took a start and went right ahead.

Mr. BURNETT, 12th line, finds the country much dried up since clearing. Had a good spring on an elevated piece of land, which gave water perpetually while the land was in bush, which is altogether dried up now it is cleared. Has some trees planted in the same spot round his house, for which he would not take any money, as the grove gives pleasant shelter. Thinks that some means, whether of planting the waste places on farms, or along roads, must be adopted, or if drying up proceeds as it has, there will be injury to all vegetation.

Mr. GIBBS, 12th line, considers the country is losing much by being denuded of trees. Showed us a beautiful piece of woods of his own, situated on a sharply sloping ground, which he is taking care of and means to keep. His neighbour has nearly cleared the same slope on his side, which will be of little benefit for crops, while he loses his bush. Mr. Gibbs considers the piece he has saved of great value to him as shelter, besides keeping a reserve of wood.

Mr. SNIDER, 12th line, believes lines of trees, especially along roads, do much good and no appreciable harm. Is planting trees himself, as fast as possible, but seasons are hurried and much cannot be done.

Mr. WATSON, 12th line, finds the greatest change, owing to the clearing of the forest, in the additional heat at night. Formerly a hot day brought a cool night, but lately the

nights also are hot. Has planted a good many maples ; thinks much more should be done in that way.

Mrs. BOWES, 11th line, finds the winds very much worse than formerly, and more destructive to orchards, but notices little changes in rainfall. Next to lines of trees the crops will be weaker for a rod. For wind-breaks, would plant along the roads. There is no perceptible injury caused by damp there, especially as in this part of the country there is little teaming done in fall and spring, the season when the trees might cause the roads to retain moisture.

Mrs. BOWES, side road, finds the orchards in great need of wind-breaks ; fruit is blown off in great quantities before ripening. When the first settlers cleared, if they had planted trees for shelter it would have been extremely valuable now, but they were too busy. Indeed, they are yet.

Mr. MARSHALL, 11th line, would rather have encouragement given to plant waste places on a farm, or on roads, than on any dividing line. A dividing line, of which his neighbour is to the south and he to the north, weakens his crops for a rod.

Mr. BURCHELL, 11th line, finds crops weaker for a rod each side of lines of trees between fields. Considers, however, that many farms are drying up and that the planting of trees is necessary. Would plant on roads and waste places of farms. Much dryer summers and springs since clearing.

Mr. BROOKS, 9th line, finds the climate totally changed by clearing, and the crops as well. For instance, formerly a new fallow when cleared would give a very good crop ; now not nearly so good a one, and full of thistles. Is not sure that lines of trees or plantations would give the old moisture back ; finds that under a line of trees for twenty feet there is a weaker crop ; but is still of opinion that there ought to be more trees preserved and grown, as it would add to the general fertility.

Mr. WAITE, 9th line, finds that since clearing the country is drying up, but can suggest no means of remedy more feasible than lines of trees along roads. This is valuable and should be carefully attended to. Where he was brought up the same had occurred ; and before he left there was neither the advantageous rainfall, or even the useful snow-fall which had been common where woods were more general.

Mr. LONG, 9th line, does not approve of trees on roads, as they keep them from drying. As for them near crops, saw no benefit in them, as near a tree the crop was poor. Had noticed no change in climate.

Mr. HOW, 9th line, finds that since the clearing up of the country, the rain, which was formerly general, now travels in lines, giving rains of perhaps a mile or two in breadth. So also with the wind ; it comes in violent and apparently narrow gales. Considers that the main chance of assisting matters by means of tree-planting is the encouragement of lines of trees along roads, where they are of great value. Would plant them to the west and south of all roads.

Mr. BRICE, 9th line, always finds trees weaken the crop under or close to them, yet thinks each farmer should maintain a grove. Trees are of great value to cattle.

Mr. ANNING, 9th line, does not like trees between fields, but considers that all roads would be the better of trees on each side. If turnpiked the roads would not be injured, while the shade would be a great benefit. The country much dryer since clearing.

Mr. McNAUGHTON, 9th line, has planted largely along the road. Does not agree with idea that proximity of woods hurts crops, for when woods were all around they had far better crops. What troubles principally now is the number of insects which were unknown formerly.

Mr. ROBSON, 9th line, has been here fifty-one years ; finds a great change in climate. Planting is valuable, but it is difficult to get those who have cleared the forest to re-plant ; still, many lines are being planted. What he would like to see would be lines of evergreens planted along exposed sides of farms. Maples, elms and poplars grow and look well, but against the cold winds of winter and spring are no protection. Evergreens are the things needed.

Mr. ELLIS, Nurseryman, 7th line, is much pleased by the impetus given to planting by the governmental reports and newspaper statements. Finds many more orders this year and last for evergreens than ever before. Has himself planted largely and finds the benefit. Considers the tall Lombardy poplars good wind-breaks, their height and rapid growth are both in their favour. Evergreens do well here. Came from Owen Sound in July; drew some black spruce out of a swamp in passing and covered the roots with damp moss; wetted them once or twice, planted them in twenty-four hours, and they all grew well.

Mr. HOFLAND, 7th line, has a very fine orchard, which only needs shelter, which he has partially given by poplars, and is planting many more. Planted lately 500 willows for a neighbour who likes them for shelter, but does not himself as they are apt to breed caterpillars. This will be the finest place for fruit in the country if only shelter by planting be given.

Mr. COX, 7th line—Here the mountain runs parallel with the lake, the water being north, leaving a strip of country varying in width at the base. The chief wind being south-west, Mr. Cox states that all is sheltered here; all Canadian crops and fruit grow well. We saw some fine trees heavily loaded with peaches, which mature well. Even a north wind from the water causes no storm, being checked in its course by the hill. Mr. Cox states that he and those on the level dwell in two climates; but that in his opinion, if they would plant rows of trees, they might be as sheltered as he.

Mr. DICE, 7th line, finds that just here, sheltered by hills and groves all round, is the best fruit country in Canada. In addition to the shelter, the lake on the north and east prevents spring frosts. There is no need at present to protect fruit trees here, so well does the present natural protection assist.

Mr. PATTERSON, 9th line. This is elevated land, above Cape Rich. There is great need of wind-breaks, the wind now blowing in a manner resembling streaks or lines across country, and often with great fury. A fourth of the roof of his barn was carried off last week. Crops can be grown close to woods on two sides without fear of rust or weakness.

Some portions of the land near here, an old resident remarks, was first settled, though it is so near the rock in part and of such hard red clay in other parts, that a number of the farms there had far better have been kept in forest. They have yielded some good crops in their days; but were not fit to last, and now are poor. If these, another old settler remarks, could be now got into good timber, it would be a most valuable work, and the best use they are fit for.

Mr. EMORY, gravel road, has long lines of tall stout Lombardy poplars on the road line, and rows of balsams protecting the sides. He finds these of great value. From the success of the experiment it is evident that along roads these would make a most valuable wind-break. They are only eighteen years old, and are sixty feet high and over eighteen inches through. They give no annoyance by suckers whatever. They are on the north side of the road.

CHAPTER III.

THE LUMBER REGIONS.

In all plans for improving our methods of forest management, which are frequently proposed, such as starting schools of forestry, introducing the scientific methods of Europe, and so on, one point has to be considered, that is, the systems of forestry in the Old and New World are totally distinct. In Europe, generally, lumber is felled or marked to be felled by the forest owners; the lumber merchant buys what is pointed out for sale.

Here, he purchases from the government of a state or province the right to take such trees as suit his purpose. There, it is generally the case that the peasant will clear the refuse for fuel, if not, it is used in manufactures, or cared for that it shall be no source of danger. Here, it is left to lie as chance throws it. This is and has been ever the case in all North America, as far as I have known or learned. The consequence has been the destruction of many fine pine forests in the United States, for fire follows the lumberman, who is forced by this method to still further wastefulness, for he cuts many young trees which would otherwise grow to large ones lest the fire take them off his hands. In Europe the forests, many of them, have been planted for the purpose, the trees stand as regularly as vegetables in a garden, and are sown, reared, and cut at stated intervals.

Immense damage has been done in Ontario, as elsewhere, by our American system, but in this Province of late years, measures have been taken to check it. A stringent Fire Act has been passed, demanding great care in the use of fire for camping and clearing purposes, and for the last two years a number of rangers, half paid by the government, half by the lumbermen, have traversed the country during the summer months to enforce it. They are employed on the application of lumbermen, who then become responsible for their share of the expense. These efforts, as will be seen by several communications following, are well spoken of. The plan is as yet not fully in operation, many lumbermen not having as yet applied for men, nevertheless, its success seems to have been considerable, for even through this last dry summer no fires at all so destructive as in former years have been reported.

Ontario has taken the lead in this matter. I do not know in America of such another Fire Act, nor of any body of rangers appointed to enforce one. Both have been favourably commented on in the Washington forestry reports, and their imitation pressed on the various state governments.

Though these steps will save much timber and far overpay their cost, yet we cannot say they will effectually preserve our forests. Time must tell. The next, if any further step be taken, must be the compulsory destruction of the refuse by the lumbermen. This is a matter for careful experiment, our climate being quite different from that of Europe, and even from that of Maine and Massachusetts. For these reasons I have recommended that this be tried on a Government reservation, where its possibility and cost can both be ascertained.

The next and final step, namely, the management, replanting, and care of Ontario forests on the European system, resolves itself into a question of expense. Such a vast reform—a reform unprecedented in America, could not be expected without the sacrifice of a very considerable portion of yearly revenue, fully, I should say, one-half of what we now draw from the forests. If the people of Ontario are willing to incur this, there is no reason why the object should not be attained. There are many reasons, climatic, as far as the present generation is concerned, economic, as regards their successors, to be urged in favour of such a course.

In this chapter will be sketched the condition and method adopted for dealing with the lumber regions of Ontario, showing which may be called the American, as differing from the European manner of lumbering and managing the territory where the merchantable timber is found.

These lands formerly included the whole Province, but the timber near the frontier being naturally the first exhausted, it may be said that in the Ontario peninsula west of Collingwood and Toronto, there is little left, and that in private hands. East of this line the lumber regions extend as far as Ottawa; and, passing up the Ottawa, westward, they extend along the north shore of Lake Huron (where are dense pine forests) to the Bruce Mines and Rainy River neighborhood, at the extreme west of the Province, where is still found much valuable timber. In fact, north of Lake Huron, there is very much which has never been lumbered over, though a great deal of this is overrun by fire.

The method of working these is by holding periodical sales of lumber districts, at which the highest bidder obtains the right to cut timber on certain portions, called limits, for a term which is renewable at the pleasure of the Government yearly, and practically is always renewed. On the timber cut the Government afterwards levy dues each year, in proportion to the amount cut. This, it will be seen, often gives the settler, if the land has been taken up for settlement, a joint interest in the lot with the lumberman, whose interest only extends to the timber.

The lumberman camps on the limit (if a large firm, he will have many camps, and central farms and depots). He cuts such of the trees as he chooses, takes what portion of the trunk suits him, cuts it into logs, leaves the tops and branches lying in the woods, and draws the logs on sledges to the nearest water, down which they are floated to the mills, if for boards; or if square timber, continue in raft to their chosen sea-port, generally Quebec. What is sent to the mills is generally for Canada or the States, the square timber is for Europe.

What has been commonly the method practised by lumbermen is to cut, as soon as possible, the merchantable timber from all portions of their limit which are nearest to settlement, or, in other words, in most danger from fire. They will often do this as far as they intend, in two or three cuttings, in successive years. They will then sell the right to cut to a smaller firm or jobber, who will glean what they have left. What portions they have in dense green forest, more distant from settlement, they leave till the last, or cut over it at long intervals. I was shown some which had been gone over but three times in twenty years.

I have procured during the last year, opinions from a great number of gentlemen, long resident in these districts and intimately acquainted with the lumber traffic, as to the present position of affairs. From various portions of the country the opinion was expressed that in fourteen or fifteen years the merchantable pine would be gone. In other parts, where forests had been, for various reasons, not so accessible, many years' cut still remained. But the same principle governed all, of which I am about to speak.

When a forest is lumbered over on the above plan, vast amounts of resinous tops, branches, and portions of trunks, as well as many young trees cut down to clear the way, are left lying in the forest. Then, the continual passage of campers, hunters, fishermen and lumbermen, causes the lighting of many fires; and in a dry season, these are likely to set fire to the refuse above-mentioned. This being highly inflammable, spreads the fire through the forest, and wide-spread conflagrations are often the result. This pine refuse is the great block in the way of good management of our pine forests, and many plans have been proposed for using or getting rid of it. Among the former it has been proposed to make wood oil from it, as is done in Sweden, and wood wool, as made there and in other parts of Europe; also, to use them for cattle-bedding. But there are reasons against these being the true definitions sought after.

In the first place, the cause of the use of forest refuse in Europe is simple and plain. The user cannot get the forest to use; that is in the hands of some great proprietor who will not have it cut down. Next, labor is cheap and plenty, and the refuse can be gathered without great cost, or, it may be, in some places at no cost, by allowing the peasants a share for firewood of what they collect. In Canada, were an oil factory or wood fibre factory started, its proprietors would probably find it much cheaper to buy four or five hundred acres with the forest but little touched, and to manufacture them, than they would, at our prices for labour and transport, be able to search over a large extent of forest for refuse.

It would, there is no doubt, be well that these experiments were tried here, since new industries which consume previously worthless products are always valuable. But as to the point in question, they could not solve it. Say the oil produced (it is a product not nearly as well known to the world as is the fibre) competed with our own petroleum to the extent of one-half, would the cost of half our petroleum collect and manufacture our lumber refuse? But a small part of it. Add what the wood fibre might give. Mattress and cushion filling would be its principal use, and for these purposes we now import the southern moss, which serves for the chief part of such work. Of this Canada imports about 200 tons. The wood fibre would scarcely displace more in these days of spring beds. That would take but little of our timber. 'I have seen as much burnt in one logging field.

The proposal to use pine refuse as litter for animals has been frequently made, but, in the first place, it could not be transported with sufficient cheapness to compete with straw, except, as in the case with our planing mills, in the cities where it is a waste product. In the next, it would not be well to use it largely for that purpose, as the pine refuse injures land, and therefore renders the manure on many soils inferior or worthless.

The state of affairs spoken of above is now, as stated, much changed for the better by the action of the Government, which, in combination with the lumbermen, have for the past two summers had a large number of fire rangers engaged in enforcing the Fire Act, long a dead letter, which demands extreme carefulness in setting out and extinguishing fires. I find from the above mentioned correspondence that this has, in many parts of the lumbering districts, had an excellent effect, as the following passages from letters received show.

One from Rainy River says: "Forest fires caused considerable damage some years ago, along the line of the Canadian Pacific Railway, but since the Ontario Government has put the Fire Act of 1878 in force there has not been much damage done."

One from Renfrew says: "Some fifteen or twenty years ago there were several miles in extent of valuable pine country almost totally destroyed by fire, which, if still intact it would be hard to estimate the value of; but since the Fire Act has been enforced and the assistance given by the limit holders, we had not many bad fires, and do not anticipate any serious losses from that source in future."

One from Addington says: "Regarding the question of forest fires, the lumbermen in this locality have nearly all taken advantage of the Order in Council appointing fire rangers; the system has given entire satisfaction, and the lumbermen are much pleased with the results. In many cases the rangers have prevented fires from spreading in the woods: and the fact of those men being employed has had a salutary effect upon settlers, hunters and others."

One from the County of Simcoe says: "The only lumbermen who have taken advantage of the Fire Act near here, by having fire rangers appointed, are the Longford Lumber Company, who, after two years' experience, express themselves as well pleased with the results. I am in hopes that other lumbermen will avail themselves of the very kind offer of the Government, and ask for the appointment of fire rangers, as I am quite satisfied it is a move in the right direction to prevent a great deal of damage by fire."

Another, speaking more particularly concerning the Lake Huron region, says: "I am informed that the lumbermen in this section mean to avail themselves this season of the privilege they have in appointing men to guard against fire. I know that fires are causing great destruction every season on the north shore of Lake Huron, where I have been more or less the last five summers, and each summer I can see the destruction that has been made. It would take up more of your time than you could well spare for me to give you the various causes and the remedies, but unless there is something done, the Province will lose a vast amount of revenue. There are miles upon miles of young and thrifty pine timber destroyed every season that could be protected by having a good man that knew the country thoroughly, and, let him have a few Indians and keep a vigilant look-out, there could be a great amount of valuable pine saved each year."

One from Peterboro' says: "Allow me to state that bush fires have not done much damage in this locality for the last year or two. The fire rangers visited this locality last

season, and I have no doubt that such officers do a great deal to prevent fires being set out. I would quite approve of such officers."

A letter from Peterboro', speaking of the difficult nature of the job, says: "I do not know any calling at present that would so soon make an old man of a young one as forest ranging; going alone and unaided, with only a small pack of provisions, for days in the forest, stopping wherever overtaken by night, exposed to all storms." He mentions that they are not always successful, as, "granted the ranger was on the ground half an hour after a fire breaks out, I do not think one man could accomplish anything towards putting it out, as the refuse through a chopping is so inflammable in a dry season. I think, though, that the fact of a Government official being in a timber locality has the effect with the people of making them more guarded and careful, during his stay anyway; at the same time, should a man, for some old grudge, make up his mind to burn a limit, forty-five rangers could neither stop nor detect him."

NOTE.—The statement by the writer that "if he were on the ground half an hour after," etc., does not give the full idea. I have repeatedly found fires burning a month after the campers had left, generally in maple logs or old roots. With a strong wind these may "break out" and set the forest on fire; but the ranger, guided by the smoke, can often see these and extinguish them before they spread, and can also institute enquiries as to who left the fire (an illegal act), and institute a prosecution. The knowledge that this is possible, as the above writer correctly remarks, tends to make people much more careful.

A letter from Peterborough makes the suggestive statement that "All the lumbermen have not availed themselves of the provisions of the Act; some of them have, and as far as I can learn, the results have been different, according as the parties were good men for the position or not."

Some good suggestions are made in the following letter from the Parry Sound district: "A great cause of the fire following the lumbermen's footsteps is from fire started by parties holding bad feelings against lumbermen or their agents for wrongs—real or imaginary. Where a trifling matter of frivolous nature arises between the lumberman and the settler, the wealthy and powerful one is apt to crush the poorer and weaker, and subsequent fires follow, destroying thousands of dollars' worth of valuable timber for a paltry misunderstanding regarding a few cents in the beginning. I think that the Amended Act of 1880, the settler holding a third interest in the timber after the patent is issued, will have some effect in keeping the fires from fallows more confined within the radius under clearing. I think that if Government would reduce the timber dues on dead or burnt pine, lumbermen could afford to cut a great deal of the dead pine to advantage before it became wormy and dosy. Say if the dues were reduced to fifteen to twenty-five cents per thousand b.m. I don't mean to say that the dues should be reduced on the pine burnt that season; that might lead to fires being started purposely to get the advantage of the reduced dues. But whenever there is a *brulé* or a dead pinery, such timber should be cut and the dues reduced from the ordinary dues collected on green pine."

Some letters received mention that the lumbermen in their districts have not yet secured the services of fire rangers, as offered by Government, but that they are expected to do so. A frequent cause of forest fires which should be especially guarded against is mentioned in a letter from Peterboro', concerning people who cut marsh hay. "I do not think the settlers are the cause of many of the bush fires that destroy so much of our valuable forests; in fact they are interested in fires not spreading, as they are in great danger of being burnt out themselves. The fires that have done most damage in this section are not from settlers clearing, but fires from camping parties and people who cut marsh hay. When everything becomes dry in summer they will set fire to the old grass in these marshes to clean the bottom and produce a better crop. These marshes being largely in the pine forest, the fire gets out into a large tract of timbered land, destroying wealth untold. I know whereof I speak in this matter. During my seventeen years' residence in this section I have frequently seen, at a great distance, large volumes of black smoke rise up. At once I have enquired where the large fire was, and invariably the answer was, 'O, it is in such a marsh; there is a lot of hay that was not cut last year

and some one is burning it.' It is true the marsh burns over, and so does the pine adjoining. The settlers get the blame, although in most cases there is not one within miles of where the fire started."

A suggestive statement comes from Pembroke: "Most of the pine forests of the Ottawa county would not be reproductive, as the pine there growing has come to maturity and is gradually decaying, to be replaced by other kinds of wood. Where the original trees were killed by fire, some twenty years past, the young pine is just commencing to appear, seeming to take that time to allow the nursery trees to grow and shelter them."

NOTE—These nursery trees mean generally small poplar. Underneath is a covering of weeds, which gives infant pines the shelter they need. If this be found general (and it might be assisted by sowing) there is hope of future forests. The statement of the pine coming to maturity means where pine forests are tall, dense, and all large trees. Small trees have little chance there; but where light is afforded by an opening, the young trees spring up. For instance, a letter, also from Pembroke, says: "Small pine, when thinned out by lumber operators, will grow quicker; the big pine being cut and taken away leaves more earth round the roots of the young pines to feed upon. It must be like all roots, the more you thin out vegetables the larger and faster they grow—the ones that are left."

The question having been asked whether persons found it possible to obtain land ostensibly for settlement, but really to take pine, bark, etc., for sale, and abandon the lots. About thirty answers state it impracticable, in their localities, to any extent, owing to the action of the regulations; but letters from Victoria, Renfrew, Hastings, Peterboro', Parry Sound, Muskoka and Algoma, state that it is yet to some extent carried on—sometimes for bark, sometimes for pine—the settler being allowed to sell what he cuts down in the course of clearing. Underbrushing has been interpreted to be the course of clearing, as it no doubt is, but the idea given is that the parties never intend to complete it, but leave when the pine is sold. For instance, a statement from Victoria is, "There are but few lots in this district bought from the Government ostensibly for settlement; but of those located under the Free Grant Act, I am sorry to say, that notwithstanding the fact that the locatee is required to take an oath that he intends the lot for the purpose of actual settlement and cultivation, too many of them have no real intention of settling upon them, but simply to cut and sell all the saleable timber, and the result is the forests are being destroyed by being cut and hacked through, and tops of trees left scattered round to be burned up, and the remaining standing timber killed by bush fires, the real settlement of the country being thereby greatly retarded."

Another letter says: "This is carried on in this district extensively, especially on Mississauga River and St. Joseph's Island. It is not too late yet to appoint a man to attend to this."

One from Peterboro' says: "In the great majority of cases I have met the 'settler,' or 'lumberman,' as he might more aptly be called, does not want a lot unless fairly well timbered, they claiming it is impossible for a poor man to go on a wild lot and live for the first few years, unless having the forest product to help them; and, in a great many cases, the lots are afterwards abandoned; and the bulk of them, in any case, are unfit to produce food for a man and family, consisting largely, so far as I have seen, of red granite."

As to the remedy for this, a letter from Renfrew giving an opinion in which several coincide, says: "My idea is, to prevent this, no lot of land should be sold before an actual inspection of the lot and the standing timber is made by the government forest ranger, and reported; also, he should report on the soil and its fitness for farming purposes; and I further think, for a great many reasons, the supervising wood ranger should be the land agent as well."

The situation throughout the lumber districts may be stated in this manner, so far as the method of cutting previously spoken of is concerned—that is, cutting all merchantable timber in exposed localities lest fire run through it. The fire rangers have been out but two seasons, and not in all localities, for a considerable number of lumbermen have not yet availed themselves of the offer of Government to pay half the cost, if the lumbermen apply for men. The lumbermen therefore, generally, are not in a position to judge whether their claims be now sufficiently secure to warrant them in leaving the small and

medium trees to grow to large timber. As soon as this is the case they will undoubtedly do it, for there is little profit in the small trees. But there is no doubt, even with the men now out, much good has been done, and the forests are immensely more secure. As soon as the rest of the lumbermen adopt the plan, which will be, I should judge, almost immediately, so ardently did many of them express themselves in its favour to myself, it is highly probable that an entirely different state of affairs will be inaugurated in our forests.

Without some security against fire, the lumberman has no inducement to preserve the forest. In good forest economy, he should leave his medium sized pines till they grow to be large, and then cut them. But if he did, in the intervening years, they were very liable to be swept off by fire, set by careless settlers, hunters, or by even his own men. There were—and are, it is feared—men even unprincipled enough to fire valuable pineries that they might get a little work in saving what pine could be secured from the wreck before the borers got it. All around him a lumberman's limits were insecure—what was a forest to-day might be a *brulé* in a fortnight. It was no wonder he too often took what he could, irrespective of growth. But, with a sufficient number of caretakers during the “fire months,” the cost of which is trifling, compared with the property saved, a different state of things will arise. The lumberman will be careful both to leave uncut what will pay him better in future years, and will endeavor so to use what refuse is useable or saleable, so that it shall not constitute a source of danger. Many expedients hitherto impossible will then be tried. There is much to be done, but in the appointment of fire rangers a great step in advance has been taken, and an important experiment attempted. As is very correctly stated in a quoted letter, the knowledge that such officials are on the ground will do much.

In forest as in ordinary police matters, it is not because the individual inclined to offend has himself been previously punished for offending, and therefore abstains from repeating the offence, that property remains tolerably secure. It is that some individuals are known to have been punished, and that the officers are known to be on the watch to detect others. It is not too much to say that in past years the Fire Act has been a dead letter. Lumbermen, settlers, hunters, fishers, set fires as they pleased and extinguished them if they chose, which last was seldom the case. The resultant damage was, as might be expected, immense. Fires smouldered in logs till drouth and high winds excited them to action, and there was no one to stay their ravages except the immediately interested lumbermen, who thus were always interested in “cutting clean” and leaving nothing, in which case the fire, when it followed, although it destroyed many thousand fine saplings, the hope of future forests, yet did not injure themselves, they having taken all which was saleable before. But now what may be expected is as follows:—

Word will, after a few convictions and punishments, go through all these districts, indeed through some it has already gone. The fisher, the hunter, the geologist (sometimes the worst of all, as our quoted extracts show) will be warned at the taverns where they stop. “You must mind your fires; so-and-so left theirs, and were tracked, summoned and fined.” For fire is a thing which leaves its plain traces, and if the rangers follow out the instructions carefully, affords every opportunity of proving the effects of their carelessness against those who misuse it. The effect will be that those who set fires at their camps will extinguish them (they are always near water), and that those settlers who burn fallows will notify their neighbors before doing so, and will take far greater pains to prevent the spread of the flames into the forest beyond their clearing.

A suggestion is made in a letter from Nipissing concerning the danger of pine rubbish left in the bush. He thinks that much of the evil is owing to part of the top of the tree containing one, or sometimes more, knotty but still merchantable logs, being left lying, the lower part of the tree being taken. He proposes that all logs so found should be charged dues, and says: “If lumbermen knew they were to pay a duty on that left, which competent men could easily prove and could not be gainsaid, there would be removed the very thing which causes bush fires; the top logs being resinous or pitch, and which would be considered valuable timber on the second or third cut, but it is useless

then as the worm has got into it. Perhaps the lumbermen may say they could not afford to pile the brush tops ; I say it will pay them."

A statement from Brudenell says :—" I think a very good way would be to have the whole tree taken out butt and top, and leave none to waste in the woods ; in this way much valuable timber would be saved to the country every year, and by cutting only the largest trees and leaving the smallest ones to grow for whatever number of years would be deemed advisable, I think lumbering could be prolonged to an indefinite period ; but on the outlying portions of timber berths and adjoining the settled parts of the country where there are patches of farming lands, it is hard to prevent squatters from going in on them, and would say that whatever pine may be in such places might as well be cut. Immigrants are coming in every year and want land."

A correspondent remarks that, on the north shore of Lake Huron, there are large groves of young, thrifty pine which need protection from fires.

A gentleman writing from the Parry Sound District states :—" There are thousands of acres of woodlands in these districts not suited either for grazing or farming which would be better left in the wild state of nature, than to be opened up for locatees who come in and locate on such lands and start to slash and burn what they think a farm, and subsequently learn by bitter experience that they have been toiling through ignorance, trying to make arable land out of barren rocks ; finally, in disgust, they pull up stakes, and leave acres of burnt rocks and dead timber behind them. If such sections of country were examined and exempted from location the danger of fire would be lessened, and the virgin forest would be left in its natural state."

An opinion from Nipissing was to the effect that :—" I think it would be advisable to put a price on land in townships where the pine is in large quantities, I think it would have the effect of stopping squatters from going in and settling in such townships until such time as the pine had been pretty well cut off."

As has before been noticed, Ontario is now trying throughout her lumber territories the experiment of stationing during the dry summer months a large number of fire rangers to enforce the Fire Act passed some years ago. This step was advised by many people throughout the Province long acquainted with lumbering operations, and its results are now being observed. There is no doubt whatever that this will save annually a large amount of valuable timber, and prevent many fires. The question now to be anxiously considered is, whether it will prevent them to such an extent as to give practical security to the lumberman in leaving the smaller pines to grow to a large size. It has been the practice hitherto in all outlying forests or those considered in danger of fire, to cut every tree from which a tolerable log could be taken, as there was very little likelihood that, if spared, the fire, which frequently followed the lumberman's operations in consequence of the quantity of refuse he leaves on the ground, would allow it to grow. It is to be hoped that the appointment of fire rangers will effect a total change in this.

This experiment is, as before remarked, in America, unique. The habit of the North American lumberman has ever been to cut the trees, leave the refuse, and risk the fire. Under this system, we may say, the northern States of the American Union have practically destroyed their pine forests. Having been in communication lately with officials of most of the States on the subject, I have not been informed of a single state maintaining any fire rangers whatever ; I have therefore great hopes from this experiment here. Without it the chances were that in from twelve to twenty years many of our present limits would be valueless for pine ; with its aid the pine will last much longer than otherwise.

CHAPTER IV.

FOREST MANAGEMENT IN INDIA.

It is most important, in view of the fact that India is now making great advances in agriculture, and more especially in wheat growing, to notice that this capacity did not become apparent until after she had been for twenty-three years—ever since 1864—spending yearly vast sums of money in protecting her forests, and planting new ones with a view to climatic improvement. I give below a summary of the steps she has taken during late years, in this direction, compiled largely from the excellent treatise by J. Brown, Esq., LL.D., in the *Forester*. If Canada would follow the example of spending money in this manner, her sons, instead of seeking Manitoban wheat fields, might revive the almost forgotten glories of Canadian harvests.

By the way of illustration, I may mention two provinces, Assam and Burmah. The total area of Assam is 45,302 square miles. Of this area, a small portion only (6,750 square miles) is under cultivation. About 8,000 square miles are Government forests, but there is besides a very large extent of private forest. Thus, in the Goalpara district there are about 520 square miles of forest, the property of Zemindars, (large native land-holders), while in the chief tea-producing districts of Cachar, Sibsagar and Lakhimpur, there are about 550 square miles of forest land in the hands of (principally) European tea-planters. For the other districts, no definite data regarding the area of private forests are available, and there are in addition to the forest, vast areas of grass land and waste, both private and the property of the Government. Of the forests in Assam at the disposal of the Government, the area actually demarcated and set apart as reserved forest, to be permanently maintained as such, is only 2,015 square miles. As far as plans have been formed, it is intended to increase the area of reserved forest to 3,000 square miles.

The total area of the province of British Burmah is 87,220 square miles, and of this area only 5,334 square miles are cultivated, the rest being forest and grass land, nearly the whole of which is at the disposal of the Government. According to present proposals, about 3,500 square miles will be demarcated and set apart as reserved forest, and of this the demarcation of 1,600 square miles has already been completed.

In the provinces under the Government of India, not including Mysore, which is now under its own native government, the area of reserved forests which have been demarcated and set apart to be permanently maintained as forest, aggregated 14,890 square miles on the 1st April, 1880. Outside these reserved forests, a certain control is exercised over a portion of the remaining forest area in these provinces; but the forest domains of the State, which it is intended permanently to maintain as forest, have the area which is stated above.

In the Bombay Presidency the area of reserved forests aggregated on the same day, 9,670 square miles. But here, as in the provinces under the Government of India, the work of demarcation has not been completed, and is still in full progress.

In the Madras Presidency the process of setting apart and demarcating the Government forests intended to be permanently maintained, has made less progress than in any of the other provinces. There are upwards of 16,000 acres of forest plantation (twenty-five square miles), and about 279 square miles of reserves under control of the Government, selected and demarcated in the vicinity of the lines of railway, chiefly for the purpose of furnishing a permanent supply of locomotive fuel.

In the provinces under the Government of India, the area under regular plantations aggregated 32,461 acres; but in addition to this, sowing and planting and other cultural operations are undertaken annually on large extents of forest, chiefly with the object of promoting

the growth of the more valuable species. In the Madras Presidency, as already mentioned, the area planted aggregates 16,000 acres, and this includes the well-known teak plantations of the Nilambur in the Malabar district, which cover an area of 3,500 acres, the oldest portions of which were planted in 1842, and are therefore now forty years old.

In the Bombay Presidency there are no very extensive plantations, but much has been done to facilitate the regeneration of forest, particularly on the dry hills of the Deccan, by strict protection and broadcast sowing. Similar measures have been taken with great success over large areas, aggregating 68,000 acres, in the babul forest of Sind, near the banks of the Indus.

The principal kinds of trees planted are chiefly those which have already been enumerated as those which are the most important.

In the hills of the North-west Himalaya, the deodar is the chief tree planted. In the plains of the Punjab, where wood is scarce, extensive plantations have been made of sissu. Thus, in the vicinity of Lahore, on the low, moist ground near the Ravi river, and at Changa Manga, on the high ground, with the aid of irrigation, extensive sissu forests, aggregating 14,000 acres, have been raised artificially, within the last twelve years, the older trees in which are now nearly thirty feet high. The wood produced in these plantations is sold as fire-wood, partly for locomotive fuel, partly for consumption at Lahore.

Teak is planted on a large scale in Burmah, and here a plan has been followed with great success, known under the name of *toungya* teak plantations. The Karens and other tribes which inhabit the hills of Burmah, practise a shifting kind of cultivation, by cutting and burning the forests, and raising one or two crops in the ashes.

On the clearances thus made, and together with the rice, which is the chief crop raised by these people, the teak seed is sown, and the result is a complete crop of that valuable tree, provided the bamboos, the coppice shoots of other trees, grasses and herbs are completely cleared; for this is the great difficulty in all planting and sowing operations in the moister and tropical parts of India, that the growth of bamboos and other trees is so luxuriant that the teak or other kinds planted gets choked. On the system of these *toungya* plantations, a total area of 2,515 acres had been planted up to the 1st April, 1880, at a cost, on an average, of 9-14 rupees, or about 16 shillings per acre; and the plantations on this system are now being extended annually on a large scale in the forests of British Burmah.

The excellent Nilambur teak plantations have already been mentioned. There are teak plantations on a smaller scale in North Kanara, on the banks of the Kalinardi, and in many other places within the range of that tree. And as an experiment, the tree has been planted outside the limits of its natural distribution, in Assam and in the Chittagong district of Bengal.

Sál produces so freely, naturally, that plantations of this tree are not, as a rule, required. By way of experiment, plantations have, however, been established, in order to stock open, grassy plains; and the best method has been found to put out plants from the forests. A peculiarity of the sál seed is that it germinates immediately after ripening, and that it loses its power of germinating very quickly. Hence, it is neither possible to keep the seed for any length of time, nor to send it any distance.

Extensive plantations of india-rubber have been made at Assam. In its natural state this tree generally germinates on the branches of old trees. At first these seedlings make very slow progress, but they commence to grow more rapidly as soon as some of the aerial roots thrown out by the young plant have reached the ground. The young india-rubber plants require a great deal of light, which it finds more on the branches of trees than on the ground under the shade of the forest. Self-sown seedlings on the ground are only found in open places where there is an abundance of light.

Experiments were made to imitate the natural reproduction of the tree, and to sow the seeds in the forks and branches of the trees; but this process was found to be so extremely slow that it was abandoned, and broad lines were cleared, instead, through the forest, and the seedlings were planted out on raised mounds of earth. This plan has succeeded admirably, and several hundred acres have now been planted on this system.

The lines are 100 feet apart, and the distance between the plants within the lines is 25 feet. These great distances are necessary, as the India rubber fig is an exceedingly

spreading tree, which, at the distances named, may be expected to take up the greater part of the ground.

As regards the establishment of nurseries, it may be said that the general rule is to sow the seed as much as possible in their permanent sites, but that nurseries are always established simultaneously with these sowings, with the view of filling up blanks by planting out from these nurseries. In the case of some trees, such as India rubber, no sowing in the permanent sites is possible.

As regards the distances at which young trees are planted out, this necessarily varies, according to the kind of trees planted and the circumstances of the case. But it will be well to mention here that in many cases the plan of sowing or planting in lines has been found to answer best. The lines are, according to circumstances, ten, twenty, or thirty feet apart, and the distance between plants or seed plots is much less. The main object of this system is to facilitate control and to diminish expense. The system of planting and sowing in lines is particularly useful where the growth of grass, weeds, coppice-shoots, and bamboos is so heavy that the plants require cleaning during a series of years to prevent their being choked. Under such conditions it is more economical to clear the jungle only along certain well defined lines, and at the same time, as the plants grow up closely within the lines; they are soon enabled to cover the ground and draw each other up; while the elbow-room given them on either side enables the naturally stronger or more favoured plants to get the upper hand over their weaker neighbours. Thus the process of natural selection is promoted, the expense of clearing is diminished, and control is facilitated. The plan has a further advantage in India, where in most cases the thinnings of plantations are unsaleable, that, the lines being far apart, it takes a long time before the trees close overhead laterally, and before thinnings become necessary.

As regards forest trees, the most important introductions have been made from Australia. Forests, raised by planting within the last thirty years of the *Eucalyptus globulus*, or blue gum, cover large areas on the Nilgris, and several species of *Acacia* also, have been extensively planted. Other species of *Eucalyptus* have been found to thrive on the plains of North India and in some places of the North-west Himalayas.

A peculiar feature in most Indian forests is that they do not, like the Scotch fir forests of the Highlands, the beech forests of Buckinghamshire, and like most forests of Europe, consist of one or a few kinds of trees only, but that they are mixed, consisting of a great variety of trees, of which generally the majority are worthless, a few kinds only being valuable.

Thus teak is associated with a large number of other trees in the forests of Burmah or South India, and most of its companions have no (or very little) value, and cannot be utilized. This peculiar feature of the mixed forests of India renders their systematic management and working extremely difficult, and every effort is made to increase the proportion of the more valuable kinds, and to devise means for utilizing those which are of less value.

Bamboos are commonly found in many Indian forests; but while in some forests they are valuable, and can readily be disposed of, they are without any value in others; and in such places they are at a disadvantage, as they impede the development of the more valuable trees.

The demand for firewood and charcoal is limited in most parts of India. Dried cow-dung is used for fuel on a very large scale, and it would be a most important and advantageous measure to increase the use of firewood, and thus to stimulate the use of manure for its legitimate purpose. But even if the whole of the people took to using firewood for cooking, sugar-boiling and other purposes for which cow-dung is used at present in many parts of India, the demand for firewood would not be sufficient to utilize the entire mass of the less valuable woods which are the companions of teak and other valuable kinds of trees in the Indian forests.

Hence it has become necessary to devise other means for utilizing the great mass of the less valuable woods. For this purpose it has been proposed to revive and extend the old native charcoal-iron industry, and to impregnate such woods with antiseptic substances, so as to make them more durable, and hence more readily saleable. At present the difficulty remains in many forests of India that there is no demand whatever for any

except a few valuable kinds of timber ; and that as these are cut out, the less valuable kind take their places, unless much outlay is incurred in sowing and planting.

These are some of the peculiar conditions under which forestry is practised in India. Now as to the outlines of the system followed, and the present condition of the forests. The first step has been to select from the waste and forest lands which were at the disposal of the Government, certain areas most suitable to be permanently maintained as forest, to place them under efficient protection, and to improve them steadily, so as to increase the proportion of the more valuable kind of trees.

The first and most important step which requires to be taken in improving these forests is to exclude fires, which throughout the greater part of India, were formerly a regularly and annually recurring event during the dry season. The chief cause of these annual forest fires is the universal practice of setting fire to the dry grass and leaves in the hot season, the object being to produce a crop of fresh green grass for the cattle, to facilitate shooting and hunting, or to afford protection against wild animals. In many cases these fires are caused by the burning of forest cut down for toungya cultivation, or by mere carelessness.

It has already been stated that the total area of demarcated forests in British India, excluding Madras and Bombay, amounted to 14,890 square miles on the 1st of April, 1880. Of this area 795 square miles are in the Punjab where, though fires do occur, and are often very destructive, they are not a regular annual institution, and where, as a rule, no special measures are taken to guard against them. Of the forests in the remaining provinces (14,895 square miles) an aggregate area of 3,700 square miles was protected during the hot season of 1880, and a large portion of this area has been protected for several years previously. This result has not been accomplished without great labor and considerable expense, in clearing and burning lines round the portions protected, and in entertaining special guards and watchers. During 1879-80 the outlay on this work amounted to 70,000 rupees. Nor has the progress made in this work been uniform in all provinces. Thus, while in the central provinces nearly one-half of the forest area is under protection from fire, a small proportion only of the total area is protected in Burma.

Eventually it is intended to bring the greater portion of the permanent forest area under protection ; and this is necessary, for these fires injure the standing trees of all ages, destroy seed and seedlings, and cause the soil to deteriorate.

Systematic efforts to exclude fires from forests have been confined to the provinces under the Government of India, although in some districts of the Bombay Presidency, particularly in North Kanara, considerable success has been attained in this respect.

Next in importance to fire protection are plantations, which have been mentioned already ; but it is obvious that no planting operations can be of any value unless the ground on which they are made is protected from fire. It will now be understood that the production of young growth, to replace the trees when cut down, is secured partly naturally by self-sown seedlings, for which purpose protection from fire is essential, partly artificially by planting, with the special object of increasing the proportion of the more valuable kinds in the forest.

The surplus revenue yielded to the state by the management of these forests is not as yet very large. The reason of this is that cuttings are restricted to the utmost, and that attention is chiefly devoted to the formation and improvement of these forest estates. Yet the revenue yielded by these estates is increasing steadily, though the charges for protection and improvement have necessarily risen in a larger proportion.

A word should now be said regarding the establishments employed for the protection and management of these forests. The chief forest officer in each province or sub-division of a province is styled "Conservator of Forests."

The circuit under his control is sub-divided into a number of divisions, each division forming the charge of a superior officer, generally a Deputy or Assistant Conservator. Divisions are sub-divided into ranges or executive forest charges. Ranges are the most important unit in the whole organization. Their extent varies exceedingly, but it is probable that eventually an average area of about thirty square miles, or 20,000 acres, will be found to be the most convenient size for these executive charges. In the provinces under the Government of India it has already been stated that the area demarcated

to be permanently maintained as forest, amounts to about 15,000 square miles, and it is probable that this area will be increased to 20,000 square miles. Under these circumstances it may be assumed that eventually there will be about 660 executive charges or forest ranges in these provinces. It is intended that when the organization has been completely worked out, ranges shall be held either by rangers or by junior officers of the superior staff.

All rangers are and will be natives, so that the filling of these appointments will require the training of an efficient body of at least 600 native officers, all well educated and competent to hold executive charge of a forest range.

For the purpose of training this body of men, a forest school has lately been established at Dehra Dun, in the North-Western provinces, and the arrangement is that eight months in the year are devoted to practical training, while the remaining four months, during the slack season in summer, are devoted to theoretical instruction in mathematics, the natural sciences and forestry.

At present the number of rangers is only ninety seven, and hence ranges are frequently in charge of subordinate officers. On the successful training of the needful number of rangers will mainly depend the success of the forest administration in India, and the strength of the Forest Department will chiefly lie in the formation of an efficient body of executive officers and forest rangers.

It is here the place to say a few words regarding the arrangements made for the professional education of the officers who are destined for the superior staff of Conservators, Deputy and Assistant Conservators—in fact, of the officers in charge of circles and divisions.

As the organization of forest administration is perfected, all these officers, excepting some of the junior men, who must commence their practical career as executive officers in charge of forest ranges, will be controlling, inspecting and directing officers. The number of these appointments will therefore be limited. It is at present ninety-three, and is not likely to be increased beyond one hundred for the provinces under the Government of India.

Obviously these are most important and responsible posts; the men must be gentlemen, and they must have such a good general education as will fit them for high administration duties. Under existing arrangements, this superior class of officers is recruited by the appointment annually of a few young Englishmen, who are selected by the Secretary of State in India, on the ground of an examination in mathematics, natural sciences, and the branches of knowledge, and after going through a course of professional training in the state forests of the continent of Europe, chiefly in those of France. Here they learn the method adopted for administering large Government forest domains; they become familiar with the organization of a large public forest service; and among other professional matters of importance, they learn to appreciate the success attained by the system of natural reproduction.

From the commencement great care has been taken to maintain an intimate connection between forest administration in India, and in those countries of Europe where large areas of state and communal forests are managed according to a regular system. In building up the system of forest administration in India, we have thus utilized the experience gained in those countries by the work of centuries, instead of following the ideas and theories of individual men. The formation of the Government forest domains in India, and the organization of their management, has been a large undertaking, and whatever success has been attained in this matter is due entirely to our having utilized the experience gained in forest administration in Europe.

As far as matters have gone, the chief work in forest conservancy in India has been done by the British Government. Attempts have, however, been made by the governments of several native states to protect their forests efficiently, and to manage them on a regular system. Thus, a regular Forest Department has been established in the Nizam's dominions, in the States of Patiala and Sirmur in the Punjab, and in other native states. Some of the chiefs of the Hill States, near Simla, have entirely and successfully prohibited the annual firing, during the dry season, of the grass and forest lands in their territories, and others have established extensive forest preserves.

U. S. FORESTRY.

As what is done in the matter of forestry of the United States is of great interest to us in Canada, we quote the statement of the U. S. Commissioner of Agriculture with reference to the forestry branch at Washington. It will be seen that he recommends experiments on military reservations. Here, they are recommended on forest reservations to be set apart by the Government. Practically, what he asks is much more money to be spent in forest preservation. That spent in educating public opinion has, he says, done good service, but he asks that other and larger sums be spent in practical work :—

“I desire again to refer in strong terms to the urgent needs of the country for a changed forest policy and the requirements of the Department for a proper prosecution of needful investigations into the subject of forestry. While I have made only the usual estimate of \$10,000 for the continuance of the division, I consider this amount below the actual requirements for a line of work which, if it is to be done at all under Government control, recommendation or advice, should be pursued in a manner adequate to its importance to the nation at large.

“While, from the experience of the Old World, we may learn the effects of recklessness and waste, and the necessity for a rational forest policy, yet with our different system of land holding we cannot expect to adopt their plans of administration. While from European forest management we may learn the principles underlying forest growth and forest management in general, with our different forest, flora, and different climatic conditions, we shall have to work out our own system of management. This requires painstaking and systematic study, and inquiry at the hands of experts conversant with forestry principles and forest conditions. The Department should be placed in position to employ and pay liberally the very best talent on these subjects which the country affords.

“Regarded simply from a business point of view, the forestry problem is growing every year in importance and urgency, as the forest area is diminished by both legitimate and reckless denudation, and it should be an object of serious concern to the Government to insure continuity of supply of raw material to a lumber industry representing a capital invested of not less than \$200,000,000, not to speak of the many minor necessities of a wood supply for railroad building, manufactures and domestic purposes. Figures are at hand to prove that this supply must be waning.

“Practically there is in the United States no forest reproduction attempted or forest planting done worth mentioning, in comparison with the enormous annual consumption of forest products.

“Of still more momentous bearing upon the welfare of the country are the effects upon climatic and agricultural conditions caused by improper deforestation.

“The influence of the forest cover on water supply has become especially noticeable in those districts, which like Eastern Colorado and Southern California, are dependent for their agricultural success upon irrigation, and where a diminution and irregularity of the wonted water supply has gone hand in hand with the havoc and desolation wrought in the mountains adjoining by reckless denudation.

“While, through publications from this Department and other sources, through agitation and discussion by societies and newspapers, a better knowledge of the condition of our forests have been gained, and through representations of the experience of older nations the importance of the subject of forestry and the dangers resulting from its neglect are appreciated by a larger number of people than formerly, yet it cannot be said that we have come very much nearer to a practical solution of the problem. Meanwhile the difficulties in its solution are increasing as time goes on.

“As a first step of reform undoubtedly the land policy of the United States, in the timbered regions, requires a change according to the changed condition of those localities. A state of affairs which allows railroad companies, miners, prospectors and settlers to cut

timber on the public domain as their wants require, without any proper supervision, without proper opportunity of acquiring either material or timber land by purchase, holds out a premium for fraud, theft and immorality. The inadequacy of the force to prevent depredations and to enforce existing laws is productive of the most reckless devastation of these mountain forests, while the value of timber destroyed by fire in one year in Colorado alone would suffice to pay a force of a thousand forest guards.

" Besides the good example which the Government may set in taking better care of its own timber lands, it might appropriately extend its operations, by planting on a large scale, in bodies of several contiguous sections, in the treeless states and territories of the west.

" The military reservations in those states, owned by the General Government, would form a most desirable field of operation. Only by such extensive planting can a desirable modification of the extremes of climate on the western plains be expected.

" If, as seems contemplated by Congress, the so-called timber-culture Act should be repealed, I would suggest that this be not done without in some way making proper provision for timber planting on homestead entries. More good is to be expected from such planting, where the owner is near at hand to watch and give needed cultivation, than in the case of timber-claim planting, which to a large extent has been practiced, it is alleged, for mere speculative purposes.

" To bring the educational institutions into sympathy with the forestry movement, and to interest them in forestry matters, the public school organizations of several states have been invited to co-operate in gathering the forestry statistics of their localities, and schedules for phenological observations have been distributed among the agricultural colleges and several thousand private observers.

" The liability of tree seeds to deteriorate when kept and the difficulty of handling most of them by inexperienced planters makes this manner of supplying material a doubtful aid to tree planters. The distribution of seedlings, on the other hand, requires a more systematic and organized arrangement than the present funds of the division will allow.

" Both the requirements of experimentation and aid by supply of material, as well as instruction in the art of forest planting and management, could be admirably complied with in connection with such plantations by the General Government as heretofore suggested.

" Several states, notably New York, Ohio, Colorado and California, recognizing the value of their forests, have instituted commissions or boards of forestry, with a view of at least protecting what remains from useless destruction. Besides the National Forestry Congress, which continues in its deserving missionary work, several state forestry associations are endeavouring to create a public sentiment in the interest of forest preservation. These endeavours are worthy of encouragement, and this Department should be authorized in its discretion to extend aid to such boards of forestry and societies by the publication of their proceedings, or in other ways.

" With the increasing interest in forestry the correspondence of a technical character is constantly growing, and this work of giving information and advice alone consumes a considerable amount of time, and requires better office facilities than it has been possible to provide without curtailing other work.

" It will appear from these statements that the work of this division ought to grow in importance as well as in scope; but that in order to do the work required for a country with such a vast area, such a great diversity of soil, climate and conditions, such immense variety of forest flora, more adequate means must be provided if it is to be more reliable, more exhaustive, and of more practical value, or a direct benefit to our people. If forethought is the root of statesmanship, here indeed is a worthy field for its exercise; for the interests of forestry lie in the future rather than in the present. It is for future generations rather than our own that we must be wise in dealing with this problem, and the time for dealing with it is now, when favourable conditions are not yet entirely lost, and while it is still possible to avoid the disastrous effects of a policy of unconcern."

WASHING AWAY OF THE LAND FOR WANT OF FORESTS.

What is especially noticeable in Ontario since our forests near the front have been largely cleared, is the quantity of valuable and fertile soil washed away into the streams. In a valuable communication sent by Joaquin Miller to the Forestry Congress, which met last month at Springfield, Illinois, the following occurs:—

"I believe it is pretty generally conceded that our continent is being washed into the sea by way of the Mississippi and its thousands of miles of tributaries on the one hand, and at the same time swept naked of its native forests by annual fires on the other. I take it that it is this deplorable condition of things that has called into existence the American Congress of Forestry. I spent some time with the late Capt. Eads at the mouth of the Father of Waters, inspecting his jetties, two years ago.

"We have begun at the wrong end," said this great man more than once to me.

"One morning he threw a bucket over the side of the boat and drew up several gallons of dark mud and water.

"There," cried the great engineer, "there is a mixture of one-tenth Missouri, one-tenth Illinois, one-tenth Iowa, one fraction Kentucky, and so on, through about fifteen states, with an addition of about five-tenths of pure water."

"And what would you do, Capt. Eads, to stop this washing away of states?"

"As I told you," remarked the energetic old man, as he dumped the ugly mixture back into the Gulf of Mexico, "we have begun at the wrong end. But the country is not educated up to the point of beginning. It wants the other end for wheat and corn. It only wants the mouth of the river kept open so as to be able to sell its corn for the present generation, and let the next generation look out for itself. The other end of the river has drowned out this end; state after state is going to be drowned out until some day the coral insect may again build his pretty castles where the people of Iowa are now digging wells for water. The United States is tearing out her very heart with her gang-plows, and dumping it into the sea, sir."

"I beg to put this statement before the country with something of the emphasis with which this great and good man uttered it there in the mouth of the great river. More than once he brought up the subject and always with an emphasis that would write every syllable in italics.

"Capt. Eads was very fond of quoting poetry. Once he was saying to himself, 'Leaves, leaves, nothing but leaves,' when he suddenly turned to me and said: 'Do you know that in leaves you can read the history of creation? My son, leaves are not only creation, but salvation.' Capt. Eads explained to me that he meant if leaves and grasses were left lying on the ground at the proper time of the year, as nature, the hand of God, placed them, there would never be any damage from high water any time; that leaves would be the salvation of the republic, and that there would never be any need for Eads' jetties. He explained that he meant when he said that leaves were creation that there is no nourishment so dear to the hungry earth as a handful of leaves. He insisted that more beauty could be grown out of a single basket of leaves than a whole load of manure.

"Well, let me tell you right here that if this process of fires and floods—floods that always follow fires—is permitted to go on by the help of 10,000 iron-toothed mills—gang-plows in the valleys to help along the flood that has gathered force in the burned-out higher land—why, we will accomplish the same desolation just as certain as water runs; only we will achieve by the aid of gang-plow and circular-saw implements, unknown of old, in two centuries what it took Babylon twenty to bring about."

FOREST CULTIVATION FOR PROFIT.

The following valuable statement is taken from the address of the Hon. Martin Conrad, of Chicago, at Springfield, last month :—

"In ever-widening circles does this destruction spread over the land. It is but a few years ago that Chicago drew the bulk of its whitewood supply from the state of Michigan—while to-day, that great timber state, in common with ourselves, draws upon Tennessee and other southern districts for this valuable wood. Oak, at that time, was so abundant that it could not be profitably shipped by rail to Chicago from outside a radius of a hundred miles ; whereas, to-day, Arkansas and even Mississippi are represented in the oak supply of the Chicago yards. Black-walnut and live-oak are already practically extinct ; but long before the culmination of this ominous result—even as far back as 1868—The Hon. T. M. Edmunds in his report to the U. S. Department of Agriculture, foresaw a complete extinction of all timber resources of the United States in about fifty years. This threatened loss alone should demand prompt measures of restraint ; but the disasters that we invite, through the climatic changes that must follow our imprudence, are appalling enough to justify the gravest fear.

"It is not my purpose to introduce here any lurid pictures of calamities in store for us—as better pens than mine, guided by the hands of science have already enlightened us as to the probable course of events if the present conditions are allowed to continue. The note of alarm has been sounded long ago, and the stormy floods of the Mississippi and the Ohio have re-echoed it with terrific emphasis.

"In proof of the enormous climatic changes that can result from such a cause, I may mention that we have an actual demonstration of the whole process at our very doors. I refer to the northern domain of our sister republic of Mexico, a section whose former luxuriance of vegetation once proclaimed it a paradise, and whose mineral wealth marked a brilliant page in the chronicles of the sixteenth century. This region is to-day a parched and torrid desert land, treeless and waterless, in whose barren solitudes it would seem that few would have dared to venture.

"Yet it is a deeply significant fact that these sunburnt valleys, not only around the city of Chihuahua, but also in many other parts of that section, should be covered with acre after acre of slag from silver ore. It must be borne in mind that in all this strange region there is not a bed of coal and that, therefore, the extensive smelting operations that are evidenced by the vast fields of slag, must have required an enormous and also convenient, supply of wood for fuel. It follows then that at some distant period of the past dense forests must have covered this land, and furnished the necessary fuel, thereby completely verifying the statement of Bernal Diaz, the soldier-historian of the Cortez expedition, that they found the region covered with luxuriant woods, verdant valleys and fertile plateaus. It was the treasure hunters then who followed these conquerors that inaugurated the destruction which has extinguished these forests and swept all vegetation from the face of the land.

"With nature's sheltering mantle thus removed, the denuded earth quickly yielded to the influence of an already arid climate, and the desert promptly spread over the area thus prepared for it. The noble forests have vanished at the touch of civilization, and with them also, the life-giving interchange of the clouds and the dew—the balance-wheel of nature's fertility. To-day only a few scattered ruins, here and there, in the midst of lonely wastes of desert, are left, to speak of their former beauty and grandeur. Could the explorer Cortez, and his devout historian, at this moment look upon those beautiful valleys of 350 years ago, viewing again the scenes of their adventures and discoveries, their pious catholicism might be charmed by the sight of the grand cathedral, with its stately towers, costing almost a round million of dollars, as well as the beautiful park at its doors, with its fountains, trees and luxuriance of tropical plants, maintained in this splendor, by the ever watchful, artificial care of man ; but, looking beyond this little garden spot, they would search in vain for the Eden of primeval beauty that first met their wondering gaze, for their eyes would rest only upon the dreary desolation and ruin which their treasure-seeking followers left behind them.

“ Fortunately, we have a prudent example before us, in the countries of Europe, in all of which the forests are under government guardianship, protecting them against fire as well as spoliation ; and, however little we may profit by this (for such a system would be a physical impossibility in this country), it may at least serve to remind us that our national legislation tends to the opposite direction, and that at least indirect relief could be afforded by admitting foreign lumber free, and thereby lessening that much of the drain upon our own resources.

“ Without stopping to discuss this point, it is worth while to see what can be done legitimately in the right direction, and to inquire if there is not a chance of redeeming the situation by intelligent and well directed individual action, with a sufficient incentive of personal profit to warrant hopes of success. If I can show that proper efforts in tree culture will prove profitable and that it is a sure and valuable investment for any farmer and land owner, this may be the means of forestalling evil results and recovering some part of what has been so wantonly destroyed.”

To bring forth adequate results, therefore, will, as I have said, require the powerful stimulus of personal gain to whomsoever shall venture his means and his time in this beneficent work. I am aware that it is the unfortunate, though general impression that no profit can possibly accrue to an investment that waits for a forest to grow up from the seed, yet I propose to show that nothing could be further from the reality. I maintain that there is a profit in it, and that a well-directed system of cultivation will not only repay the investment richly at an early period, but will be the means of solving the economic problem of our timber supply.

Any line of inquiry looking to the practical solution of this great problem must naturally begin with the number of trees can be successfully grown on a given space of land—say an acre—for a unit of calculation ; but, simple as the question may seem, it is vain to look for it in books. One German authority gives us 300 to 400 trees to an acre, as the results of an 80-year period of cultivation ; but unless we are ready to allow a good deal for the rigorous thoroughness of the forestry systems of the old country, we may be pardoned for doubting these figures. We must reflect that a square rod to each matured tree is a small enough allowance of ground space for a large healthy growth. This gives us 160 trees to an acre, but to be still more conservative, let us knock off fifty more, leaving 110 trees to the acre for the harvest eighty years after planting the seed. This result coincides exactly with the figures given by A. R. Whitney, Esq., the veteran tree grower and proprietor of the well-known Whitney nurseries at Franklin Grove, Ill.

The long practical experience of this gentleman has formulated the following method of cultivation, viz. :—

Starting with a planting of 2,720 young trees to the acre, set four feet apart, he begins by trimming out after ten years of growth every other north and south row. Five years later every alternate tree in each of the remaining rows is removed, and after another interval of five years more, cull out all imperfect growths, which will leave an average of not less than 110 trees to the acre.

To put this result in marketable form is the next step in our inquiry, that we may determine the money value of our harvest. Our leading hardwood lumbermen count an average of two trees for each 1,000 feet of lumber, and with these factors we may easily compile the following table, showing the value per acre of our 80-year crop of cultivated trees.

VALUE OF ACRE OF TIMBER OF EIGHTY YEARS' GROWTH.

Number of trees per acre	110
Number of trees to cut 1,000 feet	2
Number of feet of lumber per acre	55,000
Price per 1,000 feet	\$18 00
Value per acre, 80 years' growth	\$1,100 00
Average value per acre per year	\$12 37½

Is not this encouraging result worthy of earnest consideration by every farmer and land-owner? A little further reflection will show him that the above result is safely within the reality, as such lumber as we speak of will be worth at least \$50 per 1,000 feet eighty years hence, and he may also count upon the yearly trimmings of trees, which increase in value, growing from poles to trees that will make the very best second growth spokes, and carriage stock, as well as all kinds of the most expensive axe, hammer, and pick handles. For these purposes, a tree at thirty to forty years is of greater value than when fully matured. Besides this, we will have timber which will be useful for fuel, fencing or charcoal, and will eventually afford a steady revenue far beyond the actual cost of supervision and labour; and in addition to all this, we must bear in mind that the timber left over after the logs are cut, including the tanbark, is very nearly as valuable as the logs themselves. But you may say that a period of eighty years—aye, forty years—is a long time to await the fruits of your labour. True, but cannot its full value be realized just as readily as any of the other permanent improvements on your lands? Your investment in the tree-plantation is not locked up, for should you sell the place at any time, it will certainly take rank with the rest of the improvements as an element of value, and will bring its full price.

No other improvement on your estate can do more than this. The soil itself is certainly not as productive as it was when you first turned the virgin sod, while neither the well-appointed farm-house nor the roomy barn nor any of the other fixtures can ever realize you a cent, except as part and parcel of the whole, and then only when it passes out of your possession by outright sale. It is the sum of all these improvements that enables you to value the property at twenty times its original cost, and not because the land will produce more than it did in the past.

Your investment in the tree plantation must therefore be ranked with the permanent improvements of the place, with the additional certainty that at whatever period of its growth a transfer of ownership may take place it will invariably yield its full value; for while all the rest are undergoing the process of natural decay and require constant labor and expense to keep them in repair, the value of the tree farm until it matures is steadily accumulating with the years, and it must therefore in its intrinsic worth prove the most valuable of all the improvements on your estate.

My subject having been limited to only such woods of natural forest growth as are in present use for waggon making, I must mention that there are numerous varieties maturing at least a decade of years earlier that are possibly better adapted to our soil, which might be substituted in many branches of manufacture without affecting the quality of the article. However, as I have based my estimate of profit upon the oak, which of all species requires the longest time to attain maturity, it follows without argument that with trees of an earlier maturity the average would be proportionally larger.

Having therefore clearly shown that the culture of timber implies nothing in the nature of sacrifice, but on the contrary is a valuable source of revenue, it follows that the great problem can be solved by the incentives which nature herself holds out. She asks nothing without recompense, but offers a far more substantial reward than the mere consciousness of duty performed. Had the proprietors of the Schuttler Wagon Factory planted an oak for each one they cut down for spoke timber since the establishment of their works in 1843, they might to-day make a like amount of second growth spokes from the same ground.

And before going further, let me say that this latter fact has actually been verified in a most interesting and noteworthy manner. The factory named has just finished a wagon built entirely of cultivated Illinois timber, twenty varieties of which enter into its construction,—none of them over forty years' growth from the seed. This great variety was sought, only to show what it is possible to produce on our prairie soil, and not for lack of material,—for the entire running-gear could have been made out of one honey locust log in the lot, which measured eighteen inches clear in diameter. The entire assortment of woods was furnished by Mr. A. R. Whitney, of Franklin Grove, of whom mention has already been made.

RUSSIAN FORESTRY EXPERIENCE.

A statement made by Professor Budd, of the Iowa Board of Forestry, at the late Forestry Congress, gives a very remarkable and convincing piece of evidence. He says:—

"During the summer of 1882 I was permitted to study critically the elaborate forestry system of the Russian Empire in Europe. Prior to the time of Peter the Great we have the most complete evidence that a very large part of the black soil region east of the Volga was subject to periodic extremes of rainfall, followed by long continued drouth, during which the moisture-bearing winds from the west passed over the heated plains of Russia in Europe and Central Asia to the far off Altia range of mountains without precipitation, as they now pass over Western Texas and Southern California. Now, the planted forests on these steppes are 12,502 in number, which are under the general supervision of 762 educated directors.

"The area of these individual forests ranges from 3,000 to 30,000 acres.

"In company with forestry experts we passed through many of these island forests on the great plain, and found everywhere an attempt to preserve *real forestry conditions* by thickness of planti g, the preservation of underbrush in open parts, and the rigid exclusion of fires and stock. In all cases we found the dense sylvan shades, and the carpeting of leaves and leaf mould which keep the earth cool and moist.

"As to climatic effects, the minister of public domain assured us that the meteorological records of past 150 years, and the reported crop yields on the steppes dotted with these forests, had shown a cumulative increase of rainfall from summer showers, and a decided increase in the moisture of the air during the growing season.

"He was also positive in the statement that the modifying influence had extended into the eastern sections, with the completion of the forests, where formerly the lands had been utterly worthless except for thin and scanty pasturage.

"In the earlier history of this region the main rainfalls were in June, but since the completion of the forestry system—now covering fully 30 per cent. of the black soil area---the summer showers during July and August permit the successful culture of the sugar beet, potatoes, Indian corn and other crops requiring rainfall later than June. When questioned for the causes for the increased summer rainfall, the invariable reply of experts was, that it resulted from the *unequal heating of the air* over the plain, brought about by the large forestry areas.

"On the north plain of Europe, including North France, Belgium, Holland, North Germany, Denmark, Prussia and Poland, we found a methodic system of forestry planting and preservation, and that all classes from peasant to prince united in the belief that 33½ per cent. of the country must be kept in timber, yet we did not here find scientific men united in the belief that forestry planting directly increased rainfall. But they did unite in the belief that large areas of forest tend to a more equal distribution of the rainfall, and more equable conditions as to temperature and humidity of the air.

"On the north plain of Europe forests have existed in more or less perfect condition during hundreds of years, hence the Russian experience in the way of extended timber planting on bare pastoral steppes, like our plains west of the Missouri to Denver, has more value for our guidance.

"As nearly as we can believe any proposition of science or any established principle growing out of long experience, we may believe that the Russian plan of great island groves over our western prairies will give us a more equal rainfall and more equable conditions as to summer humidity and temperature of air.

"With a despotic form of government we might hope to try the scheme in the near future, but left to the voice of the people the time of trial seems far off. Permit me to repeat the opening remark that it is uphill work to write in a satisfactory way on a subject on which I know so little or on which so little is generally known as *prairie climatology*.

"It would have been far easier to talk of species and modes and methods of planting *the blessed timber* in which *I believe with an intensity bordering on perfect faith*, as our final saviour and preserver from climatic ills and evils which each year are becoming more apparent."

THE WESTERN PLAINS.

At the same time it may be mentioned that Dr. Berry, of Illinois, read an elaborate production which proved the author thoroughly informed on the subject of air currents and the causes which influence their course. The fact that the once verdure-clad western plains were yearly reduced to plowed ground, the further fact that the forests of the west and southwest and of the mountains were almost obliterated he said, explained to his mind the increased dryness from year to year of the air currents that sweep over the Mississippi valley. These currents are now dry and arid instead of moisture-laden as formerly. Again, tiling throughout the west rapidly carries off the rainfall to the rivers, from whence it flows in freshets to the sea, without, as formerly, remaining in the ground to become a source of vapour and clouds. The planting of forests at regular intervals throughout the west in his opinion, was the only remedy.

RAILROADS IN CONNECTION WITH FORESTRY.

A valuable statement in connection with the above has just been issued at Washington. Ten railroad companies, it appears, have busied themselves with tree-planting to a greater or less extent, of which the Kansas City, Fort Scott and Gulf R.R. have done most, having 1,300 acres in fine trees, six years old. The Acheson, Topeka and Santa Fe R.R. have started plantations at different points along their line, cultivated them carefully for five or six years, after which time they were left to care for themselves. They made good growth, and seemed perfectly at home in what was then a treeless country. Since that time settlers have occupied the ground, and many of them have planted trees in great numbers. The intention was to show an example, and it proved quite successful. The Missouri Pacific R.R. have planted 250,000 trees, which are doing well. The Southern Pacific R.R. have planted very large numbers.

To supply continuously the present demand for wood for railway construction in the United States it is calculated would necessitate a reserve of not less than a hundred million acres of well-stocked, thrifty forests.—Statement of Mr. Fernow, Forest Conservator, Washington.

One-sixth of all the fires reported are attributed to railroad locomotives. Some statements are made as to the liabilities of railroad companies in these cases as follows:—

In Colorado, for example, railroad companies are required to have a strip of ground not less than six feet wide, ploughed every year, between July and October, on each side of the line of road, sufficient to prevent the spread of fire. This is not required within the limits of towns or cities, or on roads running through mountains where ploughing would be impracticable.

In Connecticut the statute declares the fact that a fire was occasioned by a locomotive shall be *prima facie* evidence to charge with negligence those owning or operating the railroad on which the locomotive was in use. In Massachusetts, whoever wilfully or without proper care sets fire to the property of another is liable to a fine of \$250, and fire wardens are directed to prosecute such offenders.

In Illinois the fact that a fire has been started by sparks from a locomotive is made, as in Connecticut, presumptive evidence of criminal negligence.

The law of Maine enacts that when property is injured by fire communicated by a locomotive, the corporation using it is responsible for such injury, and it has an insurable interest in the property along the route for which it is responsible, and may procure insurance thereon.

In Maryland railroad companies are responsible for injuries occasioned by fire, unless they can prove to the satisfaction of the court that there was no negligence.

In Michigan railroad companies are made liable for all loss or damage occasioned by the engines or employes of such companies. It is provided, however, that they shall not be liable if the engines are in good order and properly managed; all proper precautions are taken to prevent the origin of fires, and proper efforts are made to extinguish fires in case of their extending beyond the limits of the road, when the existence of such fires is communicated to any of the officers of the road.

In New Hampshire railroads are made liable for all damages. They are also declared to have an insurable interest in all property on the line of the road exposed to damage.

The law of Vermont is similar to that of New Hampshire.

In New Jersey it is provided that engines must have screens, and the fact of fire is made *prima facie* evidence of the violation of the law.

The exposure of the railroad companies to complaints on account of fires originated by their locomotives, and to suits at law for damages, as well as other reasons appealing to their self-interest, have led to many and protracted experiments for the purpose of preventing damage to property arising from this source and inconvenience to passengers. Many contrivances for this purpose have been tried. Some have been, in a degree, successful, but most of them have proved failures in practice. Within a few years, however, spark-arresters have been devised which railroad engineers and managers declare to be so efficient in securing the end desired, that it would seem to be imposing no hardships on the railroad companies to compel them by law to furnish all their locomotives, as a condition of their use, with one or another of these safeguards. An eminent expounder of the English common law says that though railway companies may be expressly authorized by statute to use locomotive furnaces of a dangerous character, "no statute can exempt them from the consequences of negligence in the management of their railways, or the construction of their fire-boxes, chimneys or furnaces, whereby coals of fire are thrown on the adjoining property. If they neglect to avail themselves of all such contrivances as are in known practical use to prevent the emission of sparks from their engines, they will be responsible for their neglect, and if they run locomotives without statutable authority, in that case they are responsible for any damage caused by such engines in setting fire to adjoining property or otherwise, although they have not been guilty of negligence."

It would seem (says the report) that our interpretation of common law should be as extensive as that of England in protecting property from destruction by fires originating from passing locomotives, or that our statute laws should be made to accomplish the same end.

SUPPLY OF WHITE PINE.

Of late years, many have prophesied the complete destruction of the white pine forests of America, have pointed out the amount yearly used, and thence calculated the period of its duration. Their prophesies have not been accurate, for according to many of them the pine supply would have ceased before to-day, whereas the fact is that the supply is still immense. The mistake in these calculations was that they did not allow for the fact that forests then considered thoroughly culled have since been gone over again and again, and large supplies drawn. We use, too, inferior wood. To-day a class of pine is used for many purposes which would have been thought too poor for these uses twenty years ago. Hardwood and hemlock, also, which would not have been touched when pine was plenty, are now largely drawn upon. The south, too, is furnishing pine, though, as said below, she is using more than formerly. But though the south has much timber, in great part it is in such inaccessible positions as to render it very costly when obtained. The

writer, who says below pine cannot be reproduced, probably means that in our lifetime we cannot grow a large pine. But I remember fields of forty-four years ago, now pine groves, whence could be cut many sticks of thirty feet, and eight, or even ten, inches square. There is no doubt, however, that the pine of the Northern States is fast nearing its end.

It may be of interest to publish the following extracts from a letter recently received from Mr. G. W. Hotchkiss, for many years Secretary of the Lumberman's Exchange at Chicago, recognized as an authority in lumber statistics.

He says: "So far as White Pine (*Pinus strobus*) is concerned, it occupies to-day a position in forestry analogous to the Indian in the body politic, practically a thing of the past. Of course there are sections which will last for many years (not so very many either), but the great bulk is gone, and like the straggling tribes, but a remnant of former power and strength remains, and but a few decades more and they will be known only in history as a thing of the past.

"One hundred years ago, Maine, Vermont, New Hampshire, New York and Pennsylvania, could boast vast forests of white pine. West of the lakes, Michigan, Wisconsin and Minnesota, so late as fifty years ago, were unbroken in forest resources, and the white pine predominated.

"To-day Maine gives us some spruce and a little small sapling pine, such as would hardly have been sent for firewood in her palmy days of lumbering. Vermont, New Hampshire and New York may still boast an occasional clump of trees, but have lost all pretensions of lumber-producing regions. Pennsylvania has a few hundred million feet on the sides of the Alleghanies, but has dropped out of the list as a lumber producer. East of the great lakes nought remains (excepting the spruce forests of Northern and Eastern Maine), save hemlock and hardwood, and these in very limited quantities, insufficient to supply the home demand in a majority of localities. Michigan, Wisconsin and Minnesota are the last remaining resorts for lumbermen east of the Rocky Mountains. Originally there was probably 150,000,000,000 feet B. M. in Michigan, but fifty years' work has reduced the supply to probably not over twelve to twenty billion feet, with an annual average cut for the past five years of not far from four and a half billions; and the cutting is so close as to exterminate all the pine timber on the tract operated upon. Wisconsin can hardly be estimated at over thirty to thirty-five billions, little more than would suffice to supply the consumption of the United States as a whole for one year.

"Minnesota, set down in the census of 1880 as having 11,000,000,000 feet, B. M., an amount disputed by some as too high, by others as too low, if allowed to-day at 10,000,000,000, could furnish but one year's supply for the mills of the north-western pine producing states. In fact, if the mills of these three states were run to their capacity for six years, there would be but little pine left for the seventh year's production. And these estimates of timber include the red and Norway pine, which forms a noticeable percentage of the whole. In Michigan and Wisconsin there are still large quantities of hardwood, but it is not being cared for with that appreciation of its value, which is desirable. It has, however, this advantage, it can be reproduced; pine cannot. The future timber supply of the east must be largely from the hardwoods. The vast forests of the Pacific slope will supplement this with such soft lumber as may be needed. Before many years the forests of Alaska will swarm with enterprising timber seekers. Already those of California, Oregon and Washington Territory, have been the subject of research, and vast amounts of eastern capital are already invested there. British Columbia, west of the mountains, will supplement the supply, but our children will bring their pine and fir from Alaska. Meantime the supply east of the Rockies, once denuded, will be known no more, except through wise Government action in protecting and encouraging timber culture. Our present laws in this respect, so far as they relate to taking up land, are a farce, falling little short of tragedy, as the Government parts with the land without accomplishing the purpose of the grant in one case in a hundred, until it has lost control of all sufficient areas, which might be made a blessing to our successors in life's race.

"I have not for some years given the southern production so much thought, so far as statistics are concerned, and can speak only generally. There has been a great impetus to trade in the south during the last five years. You will be safe in computing the consumption of all kinds of wood at 500 feet per capita of the population, and at 8,000 feet per acre, it would take about 4,000,000 acres per year for its supply. In southern timber both the long-leaved and loblolly pine grow, and can be reproduced in their native soil, so that the statement above, that "pine does not reproduce itself," applies only to the white pine of the north. I know of no good reason why Government endeavors to foster and perpetuate large areas in the south would not be eminently successful. But it should not be delayed, as the wastefulness which has brought the white pine resources of the north so near their extinction, is rapidly doing the same for the long-leaved and loblolly of the south. It is to me a source of surprise that some of the lumbermen of the country, men who are, or have been, tramping through the forests for scores of years, are but now awakening to a perception of the true condition of our forests. That they have opened their eyes to the truth is made evident to those, who, like myself, are in position to know of the search which is being made for desirable bodies of timber, by men who six years ago set down the Government estimates and statements as veriest bosh, and loudly asserted that no diminution in present annual supplies would be seen for a generation to come."

CHAPTER V.

THE NORWAY SPRUCE.

METHOD OF GROWING IT FROM SEED.

There are many young men who intend their lives to be passed in the occupations of agriculture—the most pleasant—and if we would aid nature instead of thwarting her, not the least profitable of occupations. There are many fathers who propose that certain of their sons shall so pass their lives. Of these, some now understand; others are rapidly acquiring the idea that the forest, as represented either by lines of trees, by plantations, or by the remains of our original wood, must be retained and assisted, or our farming lands will dry into barrenness, as has been the case elsewhere. The classes of whom I speak will plant trees—many of them are planting thousands. It will be well to introduce the suggestion that, to those who have—and many have—time to look forward to in which to labour, much more pleasure can be derived from growing the tree from the seed than from buying the saplings. To see the tree, in years to come a forest monarch, burst from the diminutive seed and rear its tiny shoot amid the soil; to know that it, in days to come, deep of root and vast of spreading foliage, will act as the rain-bringer to a thirsty summer soil, and that our work has caused it, this is more than money, more than praise. Well, he who grows his seedlings can multiply the prospect by millions. And there are more than climatic considerations. "What was it," asks the observer of nations, "rendered the successes of Nelson possible? The oaks which Evelyn grew." And, without planning either the means of destruction or defence, how vast the possibilities of good to be aided by our future forests. It cannot be that in Ontario, among

our patriotic young men, we have not many an Evelyn likely to give good assistance in the task. But here let us say that, though it is fair to print the opinion of our seed-grower, himself an amateur, that all do not agree with him as to the greater advisability of buying trees. To those who have no time to spare, or who wish to save, or who want but few, it may be well. But those who can should say, grow, or attempt to grow, from seed; even the attempt will give an enthusiasm which may be lacking without. As for the deciduous trees, there is no difficulty in growing trees from their seed; do it by all means. But with the evergreens, if you can afford it, try it, there is much pleasure in it. Let us also say, this is the experience of an amateur: be not rendered timid by his doubts; he succeeded well. The next statement, that of a professional, breathes no such hesitating counsel, but says plainly that the work is easy to the careful. Naturally, all work is difficult to the careless. I trust before next year to hear of many amateur Norway spruce growers.

Of all trees fit for evergreen wind-breaks in Ontario, it seems to me that the Norway Spruce is probably the best for general purposes. Our native pine is no doubt excellent, but of much slower growth. Our balsam spruce, found in many Ontario forests, is frequently used, but I have lately heard of some failures after the age of twelve or fourteen years. The White Cedar will not grow, in some soils, to such a height as a wind-break needs, though in its native wood it produces magnificent trees. Our tamarack I have found wither and fail in numbers after twenty years. But with the Norway spruce, after having noticed it carefully in many soils and situations, I have observed no failure, except where unnecessarily pruned to a low wedge shape, which killed it. In twenty years I have known it in fair loam soil to form an excellent wind-break of forty feet in height. This was where three rows were grown, twelve feet from each other, and the trees ten feet apart. They had also the protection of a double row of pine, previously standing. It will be seen that as one tree always assists another, these had thus a special advantage; but in lines by themselves they will grow well. As it is best to give only information thoroughly practical and reliable, I have obtained from a gentleman, lately resident in Hamilton, where he grew the trees in question, a full description of his method of raising these valuable trees from seed. He had, by these means, fifty thousand young Norway spruce this spring ready to transplant. Of course, supposing the case of a small quantity, as he himself observes, it would be cheaper to buy of a nurseryman, or import from the States or Britain. But the raising of young evergreens from seed is an occupation in which much pleasure is to be found. It is also one of much pride to the successful grower, for such have been the difficulties that many have failed. It must be remembered, too, that Hamilton is in a portion of Ontario more southern and sheltered than most others. However, with the light afforded by those who have trodden the path of successful effort, there seems no reason to apprehend failure. This successful grower, an enthusiast in tree culture, I regret to say, sailed for New Zealand this spring. In his parting note to me he remarks, concerning the following directions, "I will guarantee that anyone following them will have a fine crop of trees. Remember, keep on the screens; the less sun the better the first year, but all the exposure in wet *overcast* weather, and at night *free* from frost. A very little sun morning and evening the second year; the cotton allows quite enough to pass all day through."

It would be a matter extremely valuable to Ontario if this method were practised by a few individuals who reside in suitable localities. Many millions of young trees might

be easily raised, and these dispersed through the country in protecting lines, or in broader plantations, if desirable, would be of infinite benefit. They should, to obtain a densely fibred root, be several times transplanted, after which, always remembering to keep them moist and covered between digging and planting, they will grow in most soils. I have noticed them receive a remarkable impetus from being mulched with rough manure immediately after planting; a thing which, in fact, whether with straw or manure—though the last is the best—should not be omitted with any tree. Manure is too rank, often, to dig in with the roots at planting; but mulching with it allows the filtering through the earth to the roots of the precise nourishment needed. It is, too, the easiest plan of the two. I will now give, in his own words, our spruce-grower's method and experience:—

‘It has been well said that ‘gentlemen plant trees but blackguards cut them down’—that is wastefully and wantonly—and not lightly nor recklessly should we lay hands on that mantle of living green, of all colours most restful to the weary eye, and which, cast by the hands of an All-wise Creator, drapes and veils the scars left by the Titanic struggle of fire and water.

‘It may, however be urged, by way of apology for Abithopol of these latter days, that he is perpetrating the lesser evil, when, after his bungling manner, he compasses the destruction of some patriarch of the woodlands.

‘While the ‘unsteady vulgar,’ in blind and indiscriminating fury raise axe and torch, there are, thank Heaven, a few who cherish those things, without which, earth would be a desert. Yet even of these the saying holds good, ‘Many are called, but few are chosen’; and as in the case of Gideon's followers, the paucity of their numbers does not forbid rejection, for we may say of their devotion to nature what the poet wrote of Wisdom and her worshippers:—

‘To some she is the goddess great,
‘To some the milch cow of the field.’

‘Amid all sorts and conditions of men are to be found fanatics and enthusiasts, from Archimedes to the latest discoverer of perpetual motion, who only want ‘one more wheel’ to achieve the impossible. Yet to those who may contemplate attempting to raise evergreen trees from seed, with a humorist, whom time has almost rendered classical, I would emphatically say ‘don't.’ The advice is not prompted by a sense of failure, but the late Dr. Hough, of whose kindness I have a grateful memory, quoting from Prof. H. H. McAfee (*vide* Report 1877, p. 35), says, ‘Evergreen are Larch seeds, which, by the way, ought not to be attempted by anyone not trained to the nursery business.’ It would be folly and waste, both of time and money, for anyone requiring a few thousand Pine or Spruce, to attempt raising them from seed. Far better to purchase from one of the many nurseries scattered throughout the Province; while for those who, like myself, prefer the American nurseries for the greater variety they offer, there is the gigantic establishment of Messrs. R. Douglas and Sons, Waukegan, Illinois, where, in 1871, twenty-five millions of forest trees were offered for sale; inferior only in point of size, is that of Mr. W. W. Johnson, Snowflake P. O., Antoine City, Mich. It gives me great pleasure to acknowledge the uniform kindness and courtesy of these gentlemen, to whom I am greatly indebted for information and advice.

‘Let it be granted,’ to quote from the McChokemchild bible, ‘that an attempt is to be made to raise, say 100,000 Norway Spruce. In the first place it will be necessary to select some mellow piece of sandy loam, with rather more loam than sand, and naturally dry or capable of being rendered so by drainage. It will also be necessary to have an abundant supply—natural or artificial—of water, and the means of pouring it on with unstinted hand in the parching months of the brief Canadian summer. Then in the month of September, let a plot, 120 ft. by 14 ft., be trenched two spades deep, and, at the very least, let six inches of well-rotted dung be thoroughly incorporated with the whole mass of loosened soil. No pains need be taken to level, or rake the earth, but it may be left to the action of the air and frost for the winter. If the manure be not thoroughly mixed with the soil, but be left in a mass at the bottom of the trenches, not only is it out of the reach of the young seedlings in the earliest stage of their growth, when they most need it, but as the mass diminishes in bulk, through the progress of decay, the superincumbent

earth settles, causing the formation of large and deep cracks, along which the young seedlings perish. The following spring, as soon as the ground is fit to dig, let the earth be turned over, then drive stakes four feet long by one inch by two inches, six feet apart, making two beds, 120 ft. by 6 ft., with path 2 ft. wide between the beds. The stakes should be of cedar, if the beds are to be used for a succession of years. A block of wood should be laid on the heads of the stakes, to take the blows of the hammer when driving. The lines of demarcation should be perfectly straight, parallel, and the corners should be right angles. Nail boards on inner sides of stakes, sinking them sufficiently to allow for settlement of soil, the upper edge being about 18 inches above surface of earth in bed. Each plot will now resemble a gigantic hotbed, minus the glass, and they are thus boxed in to prevent evaporation of moisture by drying winds. Let those who wish to ensure the very best results possible rake their beds level and fine, as for onions, then spread an inch of well-rotted dung uniformly over surface, to leach in with spring rains, raking off manure just before sowing, with as little disturbance of the earth as possible. We are now ready for the seed, which can be obtained from cones gathered during the previous autumn and winter. In Germany they are put in cylinders like coffee-roasters, artificial heat, obtained by burning spent cones, is applied, the cylinders being turned by hand by cranks outside the drying-room. If stored in a dry place, where a gentle heat can reach them—either that of the sun, from the flues of a greenhouse, or that from an ordinary stove, taking care that the temperature is not sufficiently high to destroy vitality—the scales will open, and beating them with a light stick will liberate the seed. It can also be procured from any respectable seedsman, or from the gentlemen I have named, at a cost of one dollar per pound and express charges. I used that from cones, and also ‘Best Imported.’ It may be fancy, but I thought the last gave slightly better results. The average production of plants per lb. of seed being 9,000 (*vide* Brown, the Forester, p. 505), we will require from 12-14 lbs. Take a small quantity of flour chalk dust, or whitening, mix with seed, and shake till every seed is thoroughly coated, so that one can detect at a glance if the seed is uniformly distributed in sowing. After all danger of frost is past, when rain threatens, scatter all but two lbs. of the seed as evenly as possible, passing a light roller, such as that of a lawn mower, carefully over the seed. To cover, a couple of cart loads of clean sharp sand, free from any admixture of soil, stones or gravel, will be needed. Such sand as that at the mouth of Grimsby Creek, or at Hamilton Beach, is the kind required, being free from any tendency to cake. This should be carefully sifted or scattered, the depth not to exceed one-fourth ($\frac{1}{4}$) of an inch. These trees—so hardy when they have attained some age—are, in the early stage of growth, of the most tender description. Heat, light and cold are alike fatal, if they can reach the frail crop. To guard against all three, screens are necessary. Messrs. Douglas employ those made of lath, the spaces being narrower than the laths; others use hurdles, made of brush, but I think that strong unbleached factory cotton, yard wide, costing 10c. per yard, is by far the best; and using this material, it will be better to make the beds 6 ft. wide, rather than 4 ft., as recommended by Messrs. Douglas. A slender framework of battens, 1x3 inches, should be built upon the boxing of the beds; the cross battens to be let in flush with upper edge of boxing, to be on edge for greater strength and free passage of light and moisture. The two longitudinal battens to be carefully put together on the flat, no projecting ends or nail heads being visible. The space between cross-battens not to be more than 3 ft.; if greater, the cotton sags in wet weather; the water collects at one point, with destructive effect on the soft earth, instead of being evenly distributed. Any method will answer that will strain the cotton to a flat surface and at the same time permit the rapid handling of the screens at the approach of rain or the breaking out of bright sunshine. These screens should be stretched as soon as possible after sowing, as birds are partial to the seed. Their edges should fit closely to the boxing, to exclude the wind, as the great area, when ‘filled,’ will severely try the strength of the material. Lastly, 50 ft. by 6 ft. is about as large a surface of cotton as can be rapidly handled by one person. It may be necessary to water the beds before the seed germinates; great care must be taken, in this event, to supply it in as fine a spray as possible; if thrown on with any weight or force, the displacement of the seed will inevitably result. In the course of a few days, if the weather be propitious, myriads of little spires will gladden

the eye by their appearance. Should these show that the seed has not been evenly scattered, the two lbs. held in reserve will make good any deficiencies. The watchful grower will observe a minute grey moth, not half the size of a small house fly, busy on no good intent. To meet these and other insect pests, the following mixture will be found of service: Eight quarts of water, and less than one teaspoonful of Paris Green; or better, eight quarts of water, one quart of strong tobacco juice, and less than one teaspoonful of coal oil—in either case to be thoroughly and intimately mixed, and applied with a fine rose on the watering pot or syringe. I find the syringe made by P. C. Lewis, Catskill, N.Y., to be all I could wish. They are expensive, but will last a careful man a lifetime. One word of caution may be useful: Never, on any account, leave the rubber plunger in the tube: it will set fast, and the effort to withdraw it will be destructive. The metal being thin, the syringe must be handled carefully. Little remains to be told. If the land has been prepared as directed, manure being applied with no stinting hand, the seedlings will come on rapidly; there will be very little ‘damping off’ or dwindling; and I believe that the taint of the manure renders them less inviting to insect attack. The careful destruction of all weeds by the finger and thumb, as soon as they appear, is a *sine quâ non*. The removal of the screens *after* sunset, their replacement before the sun strikes the beds on the return of day, frequent and copious watering when required, to be given only when the sun is off the beds, frequent syringing and incessant care and watchfulness, will be rewarded by the growth and vigor of the crop. Commencing with the last week in August, water should be withheld or sparingly applied, so that the crop may ripen the wood. When threatened with killing frosts, leave the screens on, but remove them at every possible opportunity, to subject the seedlings to natural conditions of life. They will thus be gradually prepared to bear the winter; not, however, without artificial aid. Before severe frost sets in, and, if possible, after a heavy snow fall, the beds should be closely covered with slabs or two-inch planking, as the weight of snow is often very great. Should it be necessary to cover the beds before snow falls, the planks should be piled one on the other, as the storm comes up, and the snow allowed to drift in through the openings, the planks being replaced before the subsequent thaw sets in. At the approach of the next storm, the removal of the alternate planks will cover the whole bed with a fleecy coat, the best preservative against the variations of temperature from which we suffer. The planks must be left on till all danger of winter killing is past; any seedlings hove out by the frost being carefully replaced with the fingers. The second summer is like the first—demanding incessant care and attention. Though I did not do so, I think it would be advisable to replace planking at the approach of the second winter. The third spring I would plant out, not in field rows, where the mortality may be heavy, but in nursery beds in close drills. These beds should be rich, and water and screens will be necessary till the seedlings are established, when a little of the morning and evening sun may be given. After two years in these beds the trees will be fit for field culture, in drills 14 inches apart. Space must be given in the drills, or the lower branches will be compressed into an oval, instead of expanding into the full circle. I have taken the Norway spruce as typical, the other variety of evergreens offering but little difficulty to the successful grower of *Abies Excelsa*.”—CANOPUS.

PLANTING IN SCHOOL GROUNDS.

“Let me make the songs,” said the poet, “and I care not who makes the laws.” It might be said, now-a-days, so great is his—or often her—influence, that if the school-teachers unite in favour of a policy, sooner or later it will be that of the nation. Nor is there any class to whom the future of the question here discussed could better be entrusted. Acquainted as they should be, and no doubt generally are, with the history of nations, they know that, exactly in proportion as the forests which should secure shelter and proper humidity to a country were preserved or destroyed, so the land gained or lost in

fruitfulness, and the nation in those sources of strength which the field and forest nourish. In Ontario necessary clearing has led to over-clearing ; vegetation is suffering, our timber resources are diminishing all too rapidly, and the facts need to be impressed on our youth. For this, the province looks to the aid of the teachers, and, to give some slight assistance in the way of suggestion to those teachers who may be disposed to add example to precept in the surroundings of the school, this article will treat of planting in school grounds.

The first idea of classical education we historically possess, is the remembrance of the academic groves : and surely, our school grounds, should have such appertaining ; but with how few is it the case ? The city instructional edifice is a brick building, surrounded by a Sahara of planked yard—its country relative often a wooden structure in a bleak quarter-acre lot. Nevertheless, our grumblings over the matter need not be too intense. It is progress, and great progress, that we have them at all. It is but a few years since nine out of ten of them were not. A vast advance has been made. We have the schools ; now let us have the trees.

A school should not be overhung by embowering arbors of waving foliage, nor picturesquely situated among, and half hidden by, sturdy oaks and graceful elms. Walls and roofs should be given their full chance of sun-light ; the shade is better to fight in than to live in ; an inflammatory rheumatism is too high a price for a cooling breeze. In short, it is not well to have too many trees near the house. At some distance it is well to have plenty of them.

A great point is that of shelter ; and this is generally necessary on the north and west. Nothing but evergreens will give us this, therefore along the north and along the west of our school inclosure we should have them in such numbers as the ground at our disposal will permit. For my part, I should like to see a good acre of our white Canadian pines (there is nothing better) on each such flank. There is no grove so healthy as a pine grove ; from no other such mass of leaves will come on a summer's day such balmy zephyrs to your open school-house windows. Such groves would well supplement the playground, and they would also supplement the school-house, for they would teach a lesson—a lesson not in the books, a lesson to be learned from example alone. The ground and the trees would be valuable ; they would represent money ; they might be converted into it. That they were not so converted would teach the pupils that trees had a use more valuable than to build houses withal, to be sold for a thousand pence, or to be cut down that fat bullocks might feed where once they stood.

Yet, if we have but a small lot to protect and beautify with trees, we should run a single line of evergreens along the north and west and let them branch to the ground. The evergreen needs every lower branch for many years ; for one reason, that its trunk and the ground beneath it both need shade ; for another, that your wind-break is no wind-break if the air has full sweep beneath it. For choice of trees, the pine will give a tall, dark, solid row ; the cedar, one of lower height and closer texture ; the Norway spruce, a lighter green and more picturesque line of conical summits. Of these, the cedar of course will thrive on the moister soil. And, by the way, when we come to planting them, there are four things to be looked for, namely, a small tree, good root, kept from sun and air until the moment of planting, and a depth no greater than its forest bed. It is true that by planting deeply, we hold the tree root in the ground firmly, a very necessary thing to do ; but by this over-deep planting we often find ourselves, in the course of a year or two, holding a dead stick in the ground very firmly ; not at all a necessary thing to do. The trees should be planted firmly, but where the wind can affect them that firmness should be secured by staking, not by planting the roots so deeply that heat and moisture cannot do their work. Give these a fair chance, in fair soil, and the tree will soon make itself steady enough. Till then, if necessary, tie it, and, by the way, do not let your ligature ingrow.

If there be room enough, supposing we have planted our rows of evergreens on the sides to be sheltered, we shall have an improved climate in our school grounds ; but we

can greatly add to the beauty of our row if we have room to plant another row inside, twelve feet from the first, and let this second be of the soft maple. When both are grown up, the light green in summer and the bright scarlet in the fall, of the maple, will produce a beautiful effect against a back-ground of evergreen. But this must be managed, for your maple will grow much faster than your evergreens. If in a hurry, place the maple in the rear ; if not, grow the evergreens to fifteen feet high, then plant the maples ; but you can vary this as you choose. Soft maples are cheap and easily raised ; when they grow too large, cut them down ; plant again. Nature will give you leaves and trunks in profusion, if you court her ; if you stint her, she will give you barren and lifeless stalks, as if to testify her derision. It should be remembered, too, that for the soft maple, damp ground is better, where, by-the-by, the cedar would well form your back-ground. If high ground, take the hard maple and the Norway spruce. And now two sides are done. For the rest, the south and east, we need no screens. Here we require, at fair distances, separate and beautiful trees. Say thirty feet is resolved upon, plant them fifteen, and in ten years cut out half. In the meantime, with the same expenditure of ground, you have twice as many growing trees for ornament ; and there is nothing more beautiful, if once we educate our eyes to perceive their beauty. The man who passes a succession of beautiful trees unobservant, as of so many pebbles in a walk, lives his life out without obtaining one-tenth of the pleasure his eyesight might have afforded him.

Of trees to choose from, we have in this climate a vast choice—the firm unbending oak ; the slender, lofty, swaying ash ; the urn-curved elm ; the beech, with its successional shelves of foliage ; the basswood, broad of leaf, deep of shade, white of blossom ; the white-stemmed birches, upright and conical in the cut-leaf, divergent and leaning in the common ; the maples in their infinite variety (choose the soft for the wet land) ; the mountain ash, with its clustering berries ; the larch pendulous with a myriad festoons of light and glancing green. All these, any of these, will do well for the south and east sides of your enclosure, not too near the house ; and when they grow large, not too near each other. On the north and west we want the shelter of evergreen belts ; on the south and east, merely the beautiful effect of occasional and isolated trees.

But let me take the opportunity of warning against the too common course of enthusiastic beginners, the tendency to plant largely and care for slightly. Of what use is it to plant one year numerous fine trees and in the fast following years to leave them unwatched till they dry to death slowly, or to leave them unprotected from cattle, to be bitten to death quickly ? “Ninety per cent,” writes one correspondent to me, “of our carefully chosen and nicely planted trees are now dead for want of a little care till they should grow beyond the need of care.” Let me therefore sketch the needs of tree-planting :—

All trees do well on loam, fairly drained.

Pine will grow on poor sand.

The soft maple and the cedar will flourish on a soil more moist than most others will bear ; the last on a soil rather low, however, than wet.

Mulch all trees—that is, the year they are planted spread around them straw or other such material, three feet in radius and six inches in thickness. I have seen stones used with good effect to keep this in place. This prevents the sun from drying the ground. Another way is to stir the ground shallowly twice in a summer.

Keep cattle away from all young trees. They will destroy in a minute what yourself and nature have been three years in doing.

Always remember that, if we choose to take care of a row of trees, plant them well, stir the surface frequently, or mulch it sufficiently, and generally watch their welfare, we can make that row of trees grow three times as well as will a similar line uncared for, if it live at all. There is a deep pleasure to be obtained from watching the success of a thriving plantation. The bark stands smooth, clear and healthy on the stems ; you can almost see the vigorous branches extend themselves, as if grateful for your care ; great masses of leaves, broad, bright, and many-veined, will spread themselves forth rejoicingly in the sun ; and as you seek their cool and fragrant shade, will wave and flutter above your head, an ever-changing kaleidoscope of picturesque verdancy.

When you plant your trees, grudge not a little care. What is it to bring a wheelbarrow of sand to a clayey site ; one of clay to a place too sandy ? You are planting a tree by which your grandchildren may remember you—which, perhaps, shall for many a year do its uttermost—dumb, yet living ; silent, yet sensitive—to please yourself. Its grateful shade shall cool you in the summer day ; its shelter cherish you in winter time ; or if it then be bare of every leaf, each denuded branch shall speak to you of a time when you shall also appear as lifeless, and of a resurrection as certain as the coming spring.

Pupils of the Canadian schools, the remembrance of many a century past, the knowledge of many a nation existing, lies open to your view ; the printer's art—to your ancestors for many an age unknown—sets before you the past and present as in a vast and magic glass. Look in that mirror, and you will see the citizens of certain nations, swayed by a pitiable and a mistaken view, adopt wealth as the standard of happiness, and realize by lifetimes of successive disappointments the greatness of the error they have made. Of such error is his a branch who expects to win pleasure by stripping his ground of every tree, wrenching from every rood all food that it will grow, careless that such denudation destroys the upper and the nether springs, and hinders the refreshing coming of the summer rain. Shall not yours be a different course ? The land was not given us to destroy its fertility ; to leave a desert to those who may succeed. Will you not aid what you may in benefiting your country by preserving, where you can, some slight portion of her ancient forests ; aid what you may in planting and caring for some newer trees ?

TREE-PLANTING ON ARBOUR DAY.

As of late years, our schools, invited by the Educational Department, are making some excellent movements in this direction, it is likely that at first the greatest progress will be made in and about the school grounds of the Province. Here, I must, if I suggest at all, but try to further my view, that a school ground should contain, not alone a playground, but a goodly sized grove as well. Let the boys have a couple of acres, by all means, to play in ; and two or three more where trees shall grow, and not grow sickly and stunted, but be cared for. Why, if the school teachers and school trustees of Ontario aid in the matter, we shall soon, by very force of example, have our country well sheltered once more ; and our living springs, now drying up by deforesting, bursting forth again. Give but sufficient room, and each school ground will be, so far as trees are concerned, a valuable experimental farm. What school section could not afford five acres ?—surely not one. There are many reasons for some slight liberality in this matter. Let any one observe the tramped and muddy door-yard in the small plot allotted to most county schools, (the place where, in the absence of better, they must congregate,) and think how much greater for good the influence on the pupils had they a handsome and well-sodded lawn for play—a thing attainable with ease where the number of pupils who shall tread it is not more than is ordinary in such places of education—with a pleasant grove annexed, and sheltering trees and flowers around outside the playground limits. Such surroundings dignify education and impress the pupils with ideas which may benefit their whole after lives. Or, to state the question in another way: They must have room to play ; they should also have room for trees, groves and flowers. To give them both demands more than the ordinary stinted allowance, and once afforded, if it be but cared for as the labour of so many little hands can well care for it, what lessons of order, beauty and utility can be inculcated in the process. Little can be done to beautify a pent-up quarter of an acre, through which fifty children need to run.

Well, then, suppose that five acres were allowed in each section in country localities, its exposed sides would afford an excellent opportunity for proving the benefit of evergreen wind-breaks. The whole north side might be planted with evergreens in a belt, say a hundred feet in breadth, which would afford, in summer time, a pleasing and shady grove ; in winter, a shelter against the cold winds of the north, generally our keenest visitations in that season. The western side might have a close single line of evergreens.

The others—that is the eastern and southern sides—might be bordered, as before suggested, with some of our many beautiful deciduous trees—the maple, the elm, the basswood, (this, elsewhere called the linden, I should like to see planted more extensively, Its broad, thick, soft leaves, are said, of all trees, to cast the coolest shade; its blossoms are most valuable to the bee. Pupils of English literature should not be unacquainted with Lander's touching apostrophe to the linden). Then there is the locust (where it is not troubled by the borer). But I need not extend the list, merely remarking, that if there be a place where suckers are not likely to spread, which surely should be, if any, a school ground, where there are so many hands to pull them up, the silver-leaved poplar will grow in one half the time taken by other trees. The variety with small catkins should be chosen; it does not, in the season when they fall, make one-fourth the litter made by that which grows the large; though, at some distance from a house, neither is an annoyance worth mentioning. If we choose these, a slip of eight inches of last year's wood, cut from a bud to a bud, and thrust in the ground five inches, will grow. There are many other beautiful deciduous trees; but the residents of each locality should know best what grows well there. For instance, on some high, windy plateaus, the rock elm grows well; its deep roots hold the tree firmly against a wind which would shake the roots of a young maple loose. Then there is taste to be exercised in the choice of trees as to shape and foliage. The elm will give us the tall divided stem, branching out into a curious but picturesque urn-like shape—the maple a rounded cone of foliage—the aspen a perpetual play and shimmer of changing tints—the beech great successive layers or flakes of leaf-masses. All these trees are easily grown. Then, for flowers and shrubs, the near vicinity of the school-house itself would be the place. This, as said, sketches out the idea of what might be done with a school ground of five acres. The colder sides would be walled by evergreens—say our own pines, which experience proves to make an excellent grove—the others would have their line of deciduous trees, not too near one another; on those sides we do not seek shelter, but occasional beautiful trees with broad openings between—the school-house, its shrubs and flowers, and, if you like, its verandahs and trailing vines. Ample room would be left for a broad expanse of grass-grown play-ground. Would it not be worth while to give the children this instead of the half-acre often given them?

But take the half-acre itself, if we must; what can we plant there? These small plots, planted or not, will not of themselves influence greatly the atmosphere. But they might well be the experimental commencements of what will very greatly do so. Suppose the boys try a row of evergreens, getting the little plants from the bush six inches high, planting them in beds for a couple of years, till good roots are formed, then placing them where they are needed—the best way. Or, if in a greater hurry for larger trees, get them five feet high *from the open* in the end of May or beginning of June—these are different in this respect from deciduous trees, which you may plant any time in spring or fall—they will generally grow very well, though the transplanting gives you a tree more likely to last. Or, let me suggest another thing which might be done in a school plot. Set aside a portion, sow it with tree seeds, care for the young plants, and when ready give them to such adjacent farmers as will agree to plant and attend to them on their farms. In this way the school might be made the nucleus of numerous groves and miles of wind-breaks, and the boys, grown to manhood, might view with pride their well-sheltered neighborhood—its orchards with their protecting lines of Norway spruce—its fields guarded by plantations of maple, hickory, ash, oak, and many another valuable wood—its landscape of country neither parched in summer nor wind-swept in winter, but rejoicing in alternate fruitful fields and waving woods—and say “Do you see how beautiful this is? We little fellows at school, long ago, started it all.” But Arbour Day is not confined to scholars; many a villager and many a farmer will participate in its occupations. In villages, perhaps, I might be allowed to recommend that grass be not left close to the tree. As each summer comes, if the ground be stirred around the stem, say three feet each way, and perhaps a little addition of better soil or manure mixed shallowly with the surface earth, we shall much sooner have a fine tree. Stirring the ground twice or thrice a summer is better than mulching and looks infinitely better. As regards farm planting, I would suggest that there is too much planting on the road in front of the house. It soon shuts the farm altogether from view; neither is too much of it good for the roads.

Of course the exposed sides should be planted, but when both objects can be obtained, what looks best is to see a farm protected by tree rows on both sides, by a grove at the back, and open to the road. There you see the farm, its buildings, its dark ploughed land, its green fields or its golden harvests, set in a frame of foliage on three sides—a picture worth admiring, which the next farm should vary by another, different but as beautiful. But if the roadside be thick masses of branch and leaf, as a wind-break should be, the farmer has planted you out; the farm may be worth looking at, but it will hardly please the eye of passengers who cannot see it.

I trust that, shortly, the whole population of the country regions, and many of the towns, will make a point of aiding in tree culture at least the whole of Arbour Day. For this we must look to the teachers. What they now inculcate and practice will be followed by their scholars many a year to come.

THE PROCESS BY WHICH WOODS PRESERVE MOISTURE IN ADJACENT CLEARED LAND.

We may speculate in uninformed fancies for ever without beneficial result; but if we wish the important knowledge of how best to avail ourselves of the workings of the great natural forces which, as we work with them or against them, will either render our fields fruitful or turn them to a desert, we must proceed to the workshop of Nature, and examine her operations for ourselves. If my readers will in imagination accompany me to the fields, view in fancy the young crop throwing up its millions of tender shoots, see it heighten, increase and ripen in the sun, watch meanwhile the necessary and important part which occasional moisture has in this, the sources from whence it is derived, and the manner of its aid to the growing plant, we will endeavour to get a plain and, if possible, a thorough understanding of the affair, in order to which I will ask them to read carefully the remainder of this chapter.

The history of all countries proves that when forests disappear, fertility never remains; and it has been remarked that, as one part of the method whereby this injury is inflicted, that the rapid passage of the wind over the earth, when no masses of trees break its force, must have the effect of too rapidly exhausting the moisture in the ground. The manner in which this is accomplished is very interesting, yet in all the range of the various writers on these subjects, I have not found any who had hit on the explanation of the process, (or if they had, had not thought it worth illustration), which I am about to endeavor to describe. Yet it is, of all others, the most important in connection with this matter; and, by following certain facts we know to their direct sequence, we shall find that it must be correct. In the first place we know that all plants and trees derive what food the earth gives them through openings in what are called the spongioles of their roots. But the nourishment close to these soon becomes exhausted. How does the root receive the food which lies a little way from it? By means of the great carrier of plant food—water in motion. There are two movements of water through the soil which chiefly effect this, namely, that of gravity, by which it is attracted towards the centre of the earth, or rather to a certain depth within the crust; and that of heat, which draws it up to the surface and into the air. There are other movements, but these two all are acquainted with, and it is they which chiefly do the work. And it is to be noticed that the provision of nature is that water will seldom carry plant food too deep, for most soils filter it too quickly. On the other hand, vapor does carry it upwards, as the aroma of a damp rich field when the hot sun comes from behind the clouds soon tells us. These two upward and down-

ward movements of water through the soil carry the plant food within reach of the attractive influence which roots possess. This is the principal cause, apparently, why growth is so rapid and vigorous after a shower, an assisting but lesser cause being also the cleansing of the leaves and opening of their pores by the rain. Vegetation will, at such times—while, as remarked, the water is passing through the earth downwards and upwards, (for, if watched, both these processes can be seen proceeding at one time), and during the longer succeeding period when, the first process chiefly concluded, the second, of vapor rising from the surface under the influence of the sun's heat, is still continuing—make very rapid progress indeed, so that it is common to say that the crops can then almost be seen to grow. The facts above-mentioned form a link in the chain of reasoning concerning the value of shelter to fields.

When a shower falls in summer, as noticed above, all can see the effect in increased growth. The effect is, as said, largely owing to the passage of water through the soil, both in separating and preparing the atoms of plant food in the earth for nourishment to the growing plant, and in carrying them within reach of its roots. It is now to be noticed that where fields possess the shelter given by woods this valuable process will last much longer, for this reason, that the moisture will remain in the land, drying out slowly, while in an open country it probably would not last one-fourth of the time. We will understand this better if we consider how it is that the rapid passage of currents of air across a country carries off its moisture. One stratum of air passes across the ground, and receives from contact a certain proportion of the moisture in the soil. But that stratum does not continue to pass next to the ground, for the vapor of water which it has received being much lighter than air causes it to immediately rise and be replaced by a drier one, which in its turn carries off its share. This process goes on, of course, when fields are sheltered, and is valuable to growth. But when they are not it proceeds with unnecessary rapidity, so as, especially in a dry time, when every shower is valuable, to deprive the agriculturist of much benefit his crop might have obtained from the portion of rain which fell. A sheltered field is dried by a slow upward movement of vapor. An unsheltered one is dried by the rapid, half circular, or elliptic movement of successive waves of air—a natural drying machine, in fact. From the above anyone will see the reason, so far as at present understood, why greater rapidity of growth may be expected in crops, other things being equal, where sheltered by woods or rows of trees. The passage of water through the soil, downwards by gravity, upwards by the sun's attraction, is the great means of bearing plant food to the roots. That movement is much and injuriously shortened where currents of air sweep uninterruptedly over the soil.

We will carry the description of the process of growth a little further, so as to give a fuller idea of the movement of moisture through earth and air. The plant or tree receiving nourishment by its roots receives also much water, which is the vehicle carrying it. By this it is carried to the leaves, and there exposed to the action of the air, which gives it all that portion—a very considerable quantity—of plant food, which can not be obtained from the soil, but from the atmosphere. Thence the food is sent to all parts of the plant, but the water does not remain in it; most of this has passed in vapor away from the leaves. How great the quantity of water thus passing into the atmosphere may be imagined from the fact that a sunflower has by experiment been found to emit three half-pints, and a cabbage 25 liquid ounces daily. Forests transpire millions of gallons daily, and this great transpiration of cool vapor ascending, meeting clouds charged with warmer vapor, effects precipitation, as it is called, that is to say, rain—forests being thus the cause of the descent of much more moisture than they cause to arise. These movements of heat and moisture, acting on our earth, create and nourish all vegetable life. We greatly interfere with and check their beneficial course when we deprive a land of too great a portion of its forest protection. It is not at all too much to say that now in three-fourths of settled Ontario, it is time to make the rule here as it is in Norway, that for every tree cut down two shall be planted. The woods which shelter a country are as much a means of cultivation, in their way, as are the ploughs used to turn up the soil, and the experience of other lands shows us that if the forests be destroyed, a time may come when the plough may be used in vain. I have devoted this article principally to one point in forestry, namely, the desirability of so sheltering fields as to prevent too rapid drying of the

soil after rain, and thus giving the crops for a longer space of time the benefit of the chief natural assistant of growth—the passage of water and the vapor of water—one downward and the other upward—through the soil. It would be very desirable that county or township authorities could move in this matter, so as to make the preservation of shelter general over considerable stretches of country. Individual efforts are very beneficial, but general ones would be so in a much greater proportion. I should be glad to receive and embody in the next forestry report any suggestions as to how this could be practically set about.

Another point may valuably here be noticed. As far as a pretty extended observations, field by field, can inform me, I have found that all grass crops are benefited by shelter very greatly indeed; so is fall wheat, as elsewhere enlarged upon. With other crops, such as spring wheat and barley, it is noticed that where a line of trees borders the side of the field, there will be some slowness in ripening and inferiority of grain for some few feet from the trees. This, however, seems to occur principally where the trees are close together, and the fence, also, grown up with young undergrowth. All farmers consulted agreed that with trees, say, twenty-five feet apart, which with evergreens would form a valuable wind-break, no injury whatever would occur. My own opinion is, however, that even were the wind-breaks so dense as to produce this injury for a few yards from them, the benefit to the farm in shelter from wind and shade to cattle would infinitely overpay the loss, and this is evidently the opinion of hundreds of farmers who, in our best districts, are now busily year by year planting such.

FOREST RESERVATIONS.

The portion of Ontario now mostly cleared was once a forest of beech and maple, with many another tree interspersed among, resting on soil perhaps unequalled for richness and strength. North of this was still forest, but of pine, of hemlock, or inferior hardwood here and there, on a granite basis, but its soil not at all, except in rarely occurring patches, the equal of the first, which rested on limestone rock. All through this surrounding and inferior forest the lumberman found steady work and pine in plenty, but with him everywhere the settler also strove to occupy a land not at all so well fitted for agricultural toil. Here and there is a spot propitious to his wish. But over a great part of the area he can but raise a few crops, sell the hay to the lumberman for a year or two more and leave. The fact is, much of this belt should perpetually remain in timber. But, searching for good land, the squatter wanders over it at his will, little and useless clearings are made here and there, and fires, spreading from them, do incalculable damage. It is time Ontario said to the settler, "There is much of my territory in which you are not wanted; where it is alike my loss and yours to go." It is time we understood that the cry, "Clear the forest; make the woodland into farms," has no application to the great, stony, granitic, pine-covered belt which hems our more fertile region. That is for forest, in forest for ever it should remain. It is the source of the rivers which feed our land; it attracts the rain-cloud and conserves the water-spring. It is now time that we began to make large provision to maintain a forest forever to the north. We have done enough, and too much, to dry up Ontario by clearing land in her central portions; let us not add to it the evil of ruining our rivers at their source. What is desirable to be done now is to map out large reservations, and to tell the settler that here he must not come. What welcome would a settler meet with if he ventured into the carefully preserved forest land of Europe? He would be told that a certain amount of

forest was necessary, that the rest of the land might yield returns to the plough. That amount, judging by the increasing drouth, we have fully cleared in Ontario south of Nipissing. It is now time to make forest reservations, and this article will attempt to describe more particularly their necessity and position. More, perhaps, than is advocated here should be kept sacred from the axe. But a commencement must be made, and at the least, the whole portion here recommended should be rigidly and at once set aside.

Forest reservations are of two classes; one small and of merely local benefit, the other large and of much more general value.

The first should be fostered everywhere over the land. Wherever an elevated piece of ground exists, sloping down in a long extent of cultivated land, its summit should by all means be in forest, and that for three principal reasons, namely:—

1. It will attract, or more properly, it will occasion, rain when most needed. Ranges of hills themselves, according to their height, occasion rain, because currents of moist air passing over them are elevated to a cooler atmosphere, which at once causes precipitation, as it is called, or rain. If these heights are crowned with trees, of course the air currents are elevated to a greater height, and the effect is, therefore, greater, an effect which the cool, moist air ascending from forests tends to increase.

2. A grove at the summit of a slope acts as a reservoir of moisture, holding the rain and melted snow. If the summit be cleared, and nothing there but a bare field, these waters will continually wash away the cultivable earth, leaving the hill-tops white and barren, and will gradually continue the same process from the summit of the hill downward to the river. This has occurred in many countries where the inhabitants were so unwise as to disforest the hill-tops, the slopes being now utterly barren and all the good soil washed into the valleys. But if the hill-tops be forested, the water, instead of rushing down the slopes to the injury of the land, will be retained for a length of time and gradually flow down the slope, as it is needed to moisten the ground, not in such volume as to carry away valuable and fertile earth, but in sufficient amount to benefit vegetation along the whole slope.

3. It will, in that elevated position, act as a very efficient wind-break, moderating for a considerable distance the force of the air currents, which, passing unchecked over the land, otherwise dry it out too rapidly. Every farm, however, should have its own wind-break.

The advantages mentioned above are, to a great extent, local. But a far greater and more general advantage can be obtained when a country is being cleared, if large parks or reservations, comprising many thousand acres, can be left at the head waters of leading rivers. This principle is now universally understood in Europe, and adopted wherever practicable, not only, as in America, by leaving portions of the original forests, but by planting many thousands of acres of young trees in these elevated situations. In the Alps and in different parts of France and Italy, this has been found the only method of preserving the mountain sides.

This larger application of the system of forest reservation, is not only of use where a large portion of territory is left in forest at the most elevated point or watershed of the country, to protect the sources of the many rivers which find their commencement there, but, also, that a large and elevated portion of the country may be left in forest for the purpose of attracting summer rain. If before Ontario was settled this principle had been acted on, and much of the country near Guelph left in forest, an infinite assistance would have been given to agriculture throughout the Ontario peninsula. That opportunity, however, has long gone by, but others still remain, one of which I am about to mention.

There is on the border of the north-west portion of settled Ontario a tract of country in which, as yet, no great amount of settlement exists. There—among a wilderness of balsam flats, miniature lakes, dark forests of frowning pine, burnt territory clothed with trembling aspen, here and there a hardwood stretch, here and there a beaver

meadow ; here dark rivers rolling deep beneath embowering banks ; here cataracts pouring in white foam down rocky declivities—many rivers find their source. The Muskoka, the dark Petewawa, the Madawaska, the Bonnechere—all have their sources here.

When we consider that, in the first place, this territory is the watershed and highest tableland of a portion of Ontario, millions of acres in extent, it is evident that, owing to the reasons above partly stated, its preservation in forest would be of vast importance to the Province. There is no other way in which our country, or in fact any country, can preserve its rivers.

In clearing the land, of necessity, most of the smaller creeks have been dried up, or nearly so. If now we allow it to be so completely cleared that the chief rivers also greatly lessen their summer height, the following evils will certainly occur to a very disastrous extent : The beneficial course of moisture through the land in summer will be so checked as to occasion great injury. There will be too much water in fall and spring—there will be destructive inundations—but there will be too little when it is needed for summer growth. This is not a danger of which there is no fear for a hundred years or so ; it is an immediate one. In fifty years we have lowered the water level in the land many feet : all over the country we used to get water by digging shallow wells, now we must dig deep ones. The resultant infertility is beginning to show itself. People talk of the depreciation in the value of farm property. Do they ever notice that it is because the farms will not now yield the return they did ? I am certain that, on farms which I know, and which have not been cropped extraordinarily either, it will take two dollars to grow as much as one would have grown while still there was a fair share of woods left around.

Now, among the various means of prevention of barrenness, there is not one better than the plan of making large reservations. Other countries are, as mentioned, now that forestry knowledge is becoming general, working on this plan. In Italy, France and Germany, at immense cost, forests have been, and are being, replanted on the upper slopes. New York state is endeavoring to acquire the title to and preserve the great forests of the Adirondack mountains, cutting down of parts of which have seriously lowered the Hudson. It is time Ontario did something. She now holds the title. In ten years much of the forest I mention here may have passed into private hands and be in fields.

In a forestry report of two years back I advised, with the concurrence of many leading men of the neighborhood, that a portion of the country mentioned, comprising over twenty townships, or over a million acres, should be set aside for this purpose. Mr. Russell, of Pembroke, Crown timber agent for the region, defines it as “commencing at township No. 2 of Nipissing—Elora, Maria, Head, Rolph, Wylie and McKay, in Renfrew, extending west to townships Laurier, Paxton, Butt, Hunter and Peck, inclusive.” If settlement at any bordering point has made progress, which cannot be to any great extent, the reserving line could be drawn to suit it. Much of the region is unfit for agriculture, but would be very valuable if kept in forest. Since then, Mr. Kirkwood, of the Crown Lands Department, has published an able pamphlet, recommending a reservation in the same part of the country, but not to so great an extent, namely, about 330,000 acres. I do not consider this sufficient, as the area drained is about seven million acres for the smaller reservation proposed, and the forest so left, either the smaller or the larger, would soon be the only one left in all the older settled portion of Ontario. In a short time the general cry would be, “Why was not more taken when it was so cheap ?”

The reasons for establishing such a reservation are many, chiefly, of course, that the woodland so left would exert a controlling influence in favor of agriculture by preserving the rivers mentioned, but, besides this, it would confer on the country the inestimable benefit of retaining a forest within some reasonable distance of the cities of Ontario. It must be considered that this forest would not be merely a succession of trees. It would comprise many deep valleys and many level table lands, many rapid rivers and many beautiful lakes. There would be forests of hardwood and forests of pine ; interminable stretches of balsam and of aspen, many a rugged precipice of granite, many a sparkling stream.

On such reservations as these, too, the experiment might be tried as to whether the expense of destroying the pine refuse might not be incurred, and yet the getting out and

sale of timber continue profitable. The solution of this problem is the key to the preservation of pine forests on this continent, and it would be a great step in advance should Ontario move successfully in the matter. No other question is as important. The pine-covered land will, in most cases, never make farms; but it could grow pine.

This portion is now being approached by railroads; in fact, the O. P. R. passes not far away. Its preservation would give to Canadians and tourists many beautiful camping grounds for summer residences, and would give, also, a place where fishing and shooting might long be had, with proper care to observe close seasons and to keep out hounds, creatures which never should be allowed, in fact, in any part of the country. By reserving this from settlement, too, the pine forests would last forever, if cared for, which is a very difficult matter where settlers are allowed on the few cultivable spots, for their fires will run, and their clearings will open wind-gaps and dry up the rest of the forest, which, though with care it may not blow down, yet will not be at all the rich, deep-rooted and lasting woodland which a large spread of forest affords. Neither do I think settlers should be allowed to cut down every hardwood forest in the country. It is nonsense to say that, in order to maintain a few families, hardwood worth millions in the future should be destroyed. There are townships in Canada which, had the wood been kept and thinned regularly instead of being cleared for farms, would have yielded sufficient to have enabled Government to maintain in idleness all their settlers this fifty years, and have given a large profit besides. Besides, the great fact is to be remembered that much of the section I speak of now is very poor land, where, if the settler goes, he goes to his loss, it may be to his ruin.

If it be not so preserved, what is the alternative? That its hardwood glades, forming but a small portion, should be cut down to make farms for a few settlers, who could, every man of them, do better elsewhere. That their cattle should wander through the whole forest, eating down every young sapling and drying up the woods, their fires running far beyond their bounds, and their clearances penetrating and causing to blow down a forest which ten times the labor of their lives could never restore.

It would not be necessary that the country should lose the benefit of the sales of its timber. When a tree, whether of pine or hardwood, has attained its fullest growth, it should be cut, and the number of trees annually attaining such growth within these limits would be large. But when the lumbermen has taken such trees he should not, as is too commonly his wont, hack and hew all around him. The refuse in such a reservation should be disposed of. There are methods whereby this—a difficult affair in ordinary lumbering—could be managed here.

It is to be remembered that in the reservation above sketched out, wherever timber limits have been placed under license, it would be advisable, if found convenient, in order to carry out the idea hinted at above, to make a change in their method of working. It might not, perhaps, be possible all at once to inaugurate the more desirable method, but the way in which such a reservation should be managed would be to a great extent as follows:—

1. Trees should only be cut when Government officials have marked them for that purpose.
2. No small trees should be unnecessarily cut down.
3. All branches, tops and rubbish, should be piled and burnt. Experiments could, as stated above, be carried out in such a park to ascertain the best method and cost of doing this. It might be that the cost and difficulty are too great; on the other hand, it may be that they are much less than has been imagined.
4. Careful watch should be kept to extinguish forest fires, and the Fire Act enforced throughout the reservation.
5. Licenses should be sold in the proper seasons for fishing, shooting and camping.
6. No cattle of any description should be allowed within the bounds, and no settlers, unless the necessary officials.
7. Men should be employed in summer in replanting any burnt land, and in winter in cutting up fallen trees.
8. Wherever it will grow, wild rice should be sown in the marshy grounds.

MANAGEMENT OF TREES IN CITIES.

It would seem as if, even in our cities, the remembrance and habit of our backwoods methods still cling to us ; and that here, in our streets and what should be our well-kept parks, we treat trees, ground, and branches, as if we were in the rush of a first clearing. We have parks, but where is the manure which should be spread over their lawns, at the proper time, and at the proper time raked away ? It is thrown by tons into the hollows of our ravines. We plant young trees by the hundred, and by fifties they die. Are they ever mulched to prevent it ? Not that I have seen, and I see many that are not. We trim our trees, and the rough stubs, three inches long, stand as evidence of what the pruners knew about it. Is it any wonder that many of our fine trees are beginning to die at the top, and that many of our lawns are half the time brown ? But let us investigate the subject of pruning.

If this chapter could but be read by everybody in our towns who has the care of trees, and if they would but follow one simple direction, which it principally is intended to impress—a direction which proposes to them very little extra trouble—it would be of a benefit to be valued by millions of dollars. The direction has simply reference to the matter of pruning, and does not ask of you anything more than this : that when you cut off a branch, you will—that is, if you wish to benefit and not injure the tree—cut it close to the trunk of the tree, or the larger branch from which you are cutting a smaller one. If, on the other hand, you wish to poison the tree slowly, there is no better way than to leave a few short stubs. The reason of this it is proposed to explain, for the fact is that without a certain amount of knowledge about the structure, growth, and functions of a tree, one is just about as likely to be successful in tree pruning as he would be, if similarly ignorant, in watch mending.

The trunk of a tree is composed, as all are aware, of a number of tubes, through which the sap ascends from the roots, each branch having its own set of these tubes in the trunk, arising from one particular portion of the roots. What we call the sap is largely water, mingled with plant food, of which the water is the vehicle to carry it from the earth, up through the tubes of the trunk, then through those of the branches, and out to all the leaves. In the cells of these leaves it is exposed to the air, which adds to it other materials of food, and fits the whole for nourishment. The water, which carried up the food, has now done its work, and mostly passes off into the air, while the plant food is carried back into the tree, and adds to the growth of all parts—stem and branch, leaf and twig.

Of course, when we cut off a branch, we interfere with the process ; but very different results follow in certain cases. If we cut a large one, say four or five inches through, off from the trunk, the sap is found to lodge in the tubes from the cut to the root, and to soften and discolour that portion of the wood. This injures it for timber, yet will not, for other purposes, much impair the tree, granted that air and water be kept out. The way to keep these out is to cut close to the tree, leaving all smooth and even with the bark. A little of the huige at the base of the branch, but not more than a quarter of an inch, may be left, when the cut should be painted over with coal tar, to preserve it from the weather and from cracking till the bark grows over, which it will at once commence to do, and shortly cover it smoothly and completely. It should be remarked that, if we cut off a portion of a branch, that is, one or more branches from a larger branch, still leaving plenty, say half, no injury to the wood follows, for the remaining branches have the power of perfecting the surplus sap and returning the plant food.

But when a short stub is left, a very different action takes place. The bark cannot grow over it, and the checked sap within receiving, through the rotting stub, air and

water from without, decay takes place throughout the tubes from the wound to the root, and at the stub, where the process is strongest, infects the neighboring tissues and, in a few years, forms a rotten cavity deep into the tree. Yet we often see, in Toronto, when men are set to reduce the size of trees in parks or streets, a dozen such stubs left on a tree. The consequence is that the tree, which might, had the branches removed been cut closely and the wounds painted, not have been in the least injured by the operation, weakens, and stands, during life, a sickly monument of ignorant pruning. Necessarily, for at all these points decay is weakening its fibres. A few minutes' extra work would have made all the difference.

Perhaps it may be well to say a word on the method of cutting off branches. All of those under half an inch in thickness can easily be cut with a knife, always cutting upwards, and slightly lifting the branch at the same time. When, for larger branches, a saw is used, the danger being that the branch in falling may tear away the bark below the cut, it is best first to cut from under, one-third through the branch, and then finish from above. For high branches, the use of a pruning chisel, on a long handle, will save much climbing, and with care, very good work may be done with it, always remembering in shortening a branch, to make the cut so as to shed the water.

It must be remembered that the above only applies to the deciduous trees. The great family of evergreens—the pines, the firs, the cedars—are impatient of the knife, and should never be pruned. Let them, if they will, branch to the ground; it is their nature thus to protect their bark from a heat and cold to which in their native forests it is a stranger. When older, if the lower branches die, we should remove them, but while in life to cut them creates a wound from which gum exudes for years. If it be desired, however, to check the growth of an evergreen branch, it can be effectually done by pinching off an inch or two of the ends of the fresh growth for the year.

Nothing is more astonishing than to observe the manner in which many trees, especially in the parks and streets of Canadian cities, are mangled, under the idea that they are being pruned, as if the idea was that a tree was a tree, and that any difference in its appearance was of no consequence. But there are, to those who look closely—to all those, in fact, capable of taking pleasure in the beauties of nature—no two things in the world more different than a well-cared for and an ill-managed tree. The one will be sickly, jagged, torn, its bark rotting, its branches decaying at the top. The other will be upright, its branches vigorously spreading, its bark clear, bright, with every channel accurate as if fresh from the sculptor's chisel; its leaves abundant, moist, and vivid of colour. The two trees are the types of cultivated beauty and unnecessary deformity.

In streets, and in the small plantations which surround many residences, it would often be productive of a much better effect to remove a certain number of the trees altogether than to prune them. The pruning is done with the view, in streets, of clearing the roadway of obstructing branches; and in the other case, generally, to open up a view. In both cases removal and replanting would often better answer the purpose. Young and vigorous trees are always beautiful, and give, for a long period, sufficient shade; but when they grow tall and overshadow the houses, a result which is necessarily obtained by pruning their side branches, it is doubtful whether they benefit health. They certainly cause both roofs and house fronts to decay, which never creates a healthy atmosphere. Venerable trees are excellent and valuable for many purposes; but it is doubtful whether, in streets, our object should not always be to keep lines of young trees, not too close to each other or the houses, and under twenty feet in height. This might readily be secured by proper forethought. In small city gardens, too, the same rule would be valuable; for though your high trees on the north are no harm to your house, yet they keep the south sun from your neighbors; while on east, south and west, your house is better off of no overshadowing trees. For cities, a succession of young trees, removing them when over twenty feet high, would, it appears to me, be more beautiful and more healthy than the large trees often allowed to grow. A young tree, properly cared for, is one of the most beautiful objects in the world. But the main object of this article is to say that we should never cut branches from evergreens, and that when we take them from deciduous trees, we should leave the cut perfectly smooth and level with the bark. A stub, left on one of them, rots straight to the heart of the tree.

Let us add a word on another point. We frequently see rows of young trees, planted a year or two ago, standing, half of them dead, in dryish, half-barren ground. There is no necessity for this. If we find good soil to plant in, so much the better; but trees will grow in poor soil. If we happen to have a wet time to plant in, and some damp, showery weather for some weeks after, they are almost sure to thrive, if the proper season has been chosen, and reasonable care taken to set the roots nicely and pack the earth well around them—not as hard as if we were setting a post, though; there is a medium in all things—*est modus in rebus*, says Horace. But if there be drying weather, or if the soil be poor, there is yet a way. If we procure some cartloads of manure (there is always plenty to be had in cities) and spread about a wheelbarrow load around each tree, we shall save many saplings which otherwise would have died.

HOW SETTLED ONTARIO IS SPECIALLY AFFECTED BY OVER-CLEARING.

We took possession, in its forest state, of Ontario, when it was a rich and fertile land. We grew crops of wheat which were the envy of the world. For many years back this has not been the case. For years and years we have been far below the English average. Partly this is due to the fact that we do not manure as they, nor one-quarter as much: but much more to the fact that we have dried up the land by over-clearing, and allowed the flow of water over the surface to wash away much of the rich soil into the watercourses. Exactly the same course was pursued in the Eastern States, and with exactly the same result. I passed through whole districts in Massachusetts last year which a hundred years ago grew noble crops; now, they will not give a sheep pasture. Let us examine the manner in which this comes to pass, and notice the climatic influences which have to do with our soil and its fruitfulness or sterility.

Nothing is more certain than that the south-west wind is the rain-bringer here—that is, the great current of air coming from the equator, which is laden with most of the moisture the sun draws up from the vast oceans of the torrid zone. This is always passing above us, though other winds for a time may be below it, or even interspersed with it, as, in fact, the great returning polar current often is. But the south-west current is the true moisture-laden wind—laden, it will be noticed, with moisture more heated than the atmosphere through which it passes. In converting this moisture into rain, there are two chief local agencies; one, when these currents pass over mountain ranges, which condense the moisture by lifting it into a colder stratum; the other, the cool humid air always rising from bodies of forest. This has been carefully observed in India. Sir Richard Temple, Governor-General of Bombay, says:—"The average quantity of vapour must come from the ocean, and must be condensed somewhere: if it be not changed to rain as it passes over the plains, it will pass on to the mountains and be transformed there. This, indeed, is a matter of common experience; moisture-laden clouds float over the Deccan, leaving it arid, and move on to the Satpura range (wooded mountains), and being condensed there, fill the torrent beds with rain-water, which rushes into the river beds. Similarly, clouds sweep over the thirsty plains of Hindostan, and being condensed in the Himalayas, return in the form of floods in the great rivers. It is hoped that, if forest tracts were distributed over the plains, there would be cool surfaces (*i.e.*, masses of moisture arising); it attracts the clouds, and arrests them, as it were, on their way.

Thus, it is anticipated by many that the climate would be improved and the early and the later rains descend more seasonably than at present. It is remembered that, throughout the world, those regions which possess rich vegetation receive abundant rains, while those which are denuded of vegetation, are rainless. It is remarked, too, that those regions in India which ordinarily receive rain, but have been parched by a long drought, are plagued afterwards with immoderate rain." Great sums of money have been spent by the Indian government in the assistance of tree-planting and forest conservancy, the work having been commenced in 1864. Officials have been sent to Europe to examine the systems of forest management there, and a large staff has been employed in India at the work. Now that Indian wheat is competing with our own everywhere, it is time we should notice that while they are planting trees to improve their crops, we are still injuring ours by cutting them down. But what I wished to point out was, that the rain clouds pass over us here from the ocean as they do over India, and fall in rain over the distant forests to the north, and on the great height of land beyond Superior. Until we replant more largely than at present they will continue to go there.

We may improve on our ploughs and harrows; we may experiment on an infinity of manures; we may be infinitely more rapid and correct than our grandfathers in methods of sowing and reaping; but the amount of return obtained, in comparison with the labour bestowed to obtain it, certainly does not increase. Let us take up an agricultural newspaper or pamphlet of forty or fifty years ago and observe the directions given as to the best means of securing a large yield of wheat. We shall see very little stress laid on the necessity of applying manure. The land yielded a heavy crop without. Now we know that in most parts of the country, with all our modern appliances and all our scientific farming, the average of bushels raised per acre is by no means what in former days was frequently obtained.

It was, for a number of years, common to believe that this comparative deficiency was owing to over-cropping the land, and nothing was more general than to hear opinions given that throughout Ontario, or even cultivated North America, farmers were running their land to death. But one remarkable fact was observed which completely confuted the idea that the lesser fertility was altogether due to this cause. Where a piece of land had been left till lately in forest, and was then cleared, logged, burnt off, dragged in, and, in short, all the old and almost forgotten formula of the first settlers observed, the acres no longer yielded as their fellow-acres, when first cleared, had invariably done. The great wheat ears, long and bending with their plump and numerous kernels, no longer rose enlulous almost to the height of the fence. The straw might be fair enough, but it was not what the former fallows had given. How was this? The land should have been just as rich. It was timbered with beech and maple, as had been many a field which lay beside. It had not certainly been over-cropped, for it never had been cropped at all. The question was very naturally asked, how this land, on which nothing but trees had ever previously been grown, had so evidently diminished in fertility?

The answer was not long to seek when the result of disforestation had been examined, as they have been of late years, by many scientific men. It was found that in those parts of North America where fertility had decreased too much of the formerly sheltering forests had been cut away; and that, as it is certainly known that many countries of the Old World have, by carelessly cutting down their forests, changed their good soil into barren land, so in the New World the same process has been energetically begun, and the symptoms of decreasing fertility have appeared precisely concurrent with its progress. The matter may be concisely stated as follows:—

1. A sufficient amount of interspersing forest in a country receives and stores up the moisture of rain and melting snow, allowing it gradually to pass away, thus preserving a proper quantity always in the ground and always in motion. The passage of water through the earth is so important to vegetation that it may almost be called the life thereof.

2. Where too much forest is gone the falling water or melting snow rushes rapidly across the land to the rivers, carrying away much good soil.

3. When showers have fallen, if the wind has too free course over the land, evaporation is too rapid, the earth is dried out in a short time and the benefit of the rain to a considerable extent lost. Woods, or even dense lines of trees, prevent this.

4. The benefit of shelter in winter by preventing the uneven drifting of snow, and otherwise assisting the crop of fall wheat, clover, etc., is very great.

5. Forests, also, by their constant transpiration of cool moisture in large quantities, do much, by their junction with the rain-bearing clouds, to attract, and in fact occasion, local rains while the woods are in leaf, which is the time when rain is needed.

The presence of interspersing forests being one of the chief conditions of fertility, and we, in Ontario, as well as those resident in the greater part of the continent east of the Mississippi, having been engaged in doing away with these conditions, insomuch that a great deal of the country is now quite denuded of trees, it follows that one of the chief reasons of the decreasing fertility, mentioned above, is fully before us. We have taken many steps towards the condition which has ruined the soil in other lands. The remedy is simple; it is to preserve what remnants of forests we can, and to plant wherever our means will allow.

The question has been asked, how is it that the great prairies of the Western States were ever fertile, while trees are said to be so necessary to fertility? This is easily answered. These prairies were, in the first place, of exceptional fertility, so far as regards the quality of the soil. It is a very deep, soft, rich loam, which, once receiving the benefit of a heavy rain, allows many days to pass before it is deprived of it by evaporation; or rather, it should be said, enjoys the benefit of the process of evaporation for many days. (For while moisture is rising to the surface, it is also softening plant food and conveying it to the roots, and it is furnishing these roots, also, with the large quantity of water all plants need as a carrying vehicle for food, and to supply the continual transpiration from the leaves.) Our soil in Ontario is not such. Take all the groves from the prairies, and denude Ontario of trees, both would, in process of time, become desert; but the prairie not till very many years after the other. For where nature has covered the earth with trees, there is always found a soil which a proportion of forest is needed to protect. It is laid down as a rule by those who have scientifically investigated the subject, that such a country, left one-fourth or one-third in wood, will always yield more than if all cleared and cropped, not to mention the certainty of ultimate barrenness in the latter case. There are also circumstances connected with the western prairies which render them dissimilar in rainfall to the rest of America. As has been frequently explained, the great source of rain is the wind from the equator, bearing the vast mass of moisture evaporated from the oceans of the torrid zone. To the south of the prairies are the great forests of the Gulf states, and all along their south-west stretches the great chain of the Rocky Mountains. These two, but especially the latter, condense immense quantities of this northward moving moisture, which falls in rain over the prairie states. Yet, notwithstanding these natural advantages, the great need of the prairie is now trees, and much planting is yearly done there.

In Ontario, where in many of the older settled parts we are reduced to ten per cent. of forest land, we are losing, year by year, the original fertility of the soil. It is full time that the people of every county and township took counsel as to the best way of retaining some forest protection. As far as retaining forests goes, there is but one way, and that is, if cattle be at all hungry—if they have not plenty of good grass outside—never let them into your bush. If they are to have forest shelter, by all means let them have it, but let the portion be fenced off from that which it is wished to preserve in good forest condition. If a piece of bush be taken while it is yet possessed of its original forest bed of deep-living leaves and decaying twigs, and then well fenced against cattle, it will protect itself in great part, for the young trees growing around the edges, being habituated in their early years to the sun, will grow up hardy, with deep roots. These will not blow down, and they will prevent the drying winds blowing through the rest and injuring it. The forest earth will not harden, nor be nearly so likely to become grass-grown; young saplings will continually take root and spring up, and by care to cut out old trees as soon as they are fit, and a little thinning where undergrowth is too rank, a portion of forest

may be preserved which will always yield a succession of timber, valuable for many purposes, and a continual shelter to the adjacent farm lands, which shelter is twenty times as valuable. It has been common to say "We will keep this piece of bush, underbrush it, leave only good large trees, and it will be a nice pasture for the cattle." We might as well encourage the growth of a nation by killing off all the children. The forest needs its underbrush; we may thin it, though nature would have done that in time, but we must not destroy it. The small trees keep the large ones in health, and, obeying the great law of the survival of the fittest, the weakest die off, the strongest grow to full-sized trees.

WASTE OF YOUNG EVERGREENS.

While giving careful directions how to grow evergreens from seed, and plant and care for them till they are of size to place in their ultimate position, we should remember that there are many to be had throughout the country ready for planting for nothing, and that using such, if care be taken as regards mulching and the season of planting (for they need a little more care than trees from a nursery which have been transplanted several times), will save from five to ten years' time in the work of sheltering a farm or orchard. But let my readers who plant them, spare a wheelbarrow of manure to place round each on the surface, and some straw as well. Nothing repays care better than trees.

Many letters are received, saying, "Lines of evergreens are advocated in your reports and letters, and we like the idea, as giving protection in winter; but how are we to get them in numbers at any moderate price? As for the price when purchased, I find the best of them, which is probably the Norway spruce, several times transplanted, fifteen inches to two feet high, selling in nurseries a hundred miles from the original nurseries, at \$10 per hundred. At twenty feet apart, which will, by-and-by, give a fine wind-break, though closer would be better, \$10 will plant two thousand feet—quite a long line. But the fact is that a great many fine young evergreens, both pine and cedar, which might be of the greatest use, are always going to waste in Ontario.

As I was travelling last fall towards Sarnia I passed a field where there had previously existed a considerable growth of young pine trees, self-sown originally, and arrived at the height of from three to seven feet. It was found advisable to clear up this field, in order to make use of it for the ordinary purposes of agriculture. Some seven or eight hundred fine young trees accordingly had been grubbed up, piled in heaps, and were now being burned. This was in a district almost denuded of trees, and where the sweep of the winter wind must have been something terrible of a freezing day. If, instead of burning these, they had, at the proper season, been planted along the north fence of that and the adjoining field, many crops would have prospered to better advantage for all future years, so far as the influence of their shelter extended.

All over the country, here and there, are scattered growths of young pines and cedars, which seldom serve any good purpose, being destroyed in succession when the land is needed. If farmers living near there would plant them out as shelter belts, either on the north, west, or whatever sides of their farms are most exposed to the winds, what are now of little or no value, merely large, useless weeds in many a field which they cover, would then be of the greatest use possible, and soon grow a tall and dense wall of verdure where most needed, checking in summer the influence of swift winds, which dry the land out too rapidly; preventing the snow from uneven drifting in winter, and giving that general benefit to agriculture which is best summed up in the testimony of those who have grown such protecting lines, and state that they would not, now they have experience of their

value, be without them for a thousand dollars, and that their influence must often have doubled their crop of fall wheat, since the yield, where not so protected, has repeatedly averaged only one-half of that obtained where the protection was afforded.

We are all aware that the great difficulty in this matter is that the farmer is prone to say, "Certainly, if rows of such trees were common, if every farmer could be induced to plant a line of them, the general benefit of these numerous lines, crossing the country in close succession, so that the winds would be checked, the snow kept level, and the fields protected from drying winds in summer, over all Ontario, would no doubt be remarkable indeed. But my one poor row along the edge of my farm could exercise little influence in checking the north wind or improving the climate. Get a county, or even a township to do it, and then there would be results. But why should I alone attempt to benefit the country?" Let us point out—more, let us prove beyond peradventure, that this is all a mistake. It is true that the farmer planting a row of evergreens along the north of his farm benefits the country. There is, surely, no objection in his mind to doing that. I much mistake the feelings of most of my agricultural friends, if they would not really like to do something that would benefit everybody around, whether everybody should be grateful or not. There comes a time when, though we may have thought all was unnoticed, and that we have thrown our pearls of philanthropic effort before a race constitutionally denied the power of appreciation; there comes a time when someone speaks, and we find that all was observed; that, if it were not stated in the daily advertisement, it was given full and honest credit in the ledger of the heart. "What, you thought we did not see!"

But there is somewhat immediately gained as well. It is the general testimony that wherever those protecting rows have been planted, the farmer who has nourished them to maturity, or rather to the time when their bulk is sufficient to yield shelter, is greatly benefited in several respects. And if so now, how much more valuable will they be in coming years, when, as is in too many localities the case, many relics of the primeval forest, which have as yet afforded some check to the winds, must die away, never having been properly cared for with a view to their preservation. I remember one case in point near Brampton. "I have," said a well-known cattle-breeder, "a hundred yards of hedge about twelve feet high. It keeps the snow level to my gate, and the consequence is that my path is clear enough all winter, while my neighbors have to spend about a week's work annually in digging themselves out." Wherever lines of trees have arrived at a height of thirty feet or so—if they be evergreens, for others yield little protection in winter—the crop of fall wheat and grass for twenty or thirty rods have, say many farmers, been much better, while as far as fruit is concerned, the trees thrive and yield twice as well. "I can," said one farmer, who had a good line of white pine trees, thirteen years old, along his farm edge, "now stand to cut wood in a storm with my coat off, and be comfortable; and that alone I would not lose for \$500, not to mention the good it is to the rest of the farm." One of the most successful I know of was, when planted about eight years, fifteen feet high, with a spread of eight feet at the ground, stems about six inches thick. This was of ordinary white pine, taken from pine openings, being saplings of about six feet in height, transplanted as quickly as possible after moving, and taking up as much sod and root as would well carry. Planted about the 6th or 7th of May. Not five per cent. died, and these were replaced at once. This is in Bosanquet, and is said by the owner to make always at least three degrees difference in stormy weather round his dwelling; he has, as he remarks, "to go off the farm to know how cold it is."

What would be most valuable in any movement of the sort would be the general and united action of a locality. Each owner can no doubt benefit himself by such work; but each owner would be doubly benefited if his neighbors seconded his efforts. In other words, a succession of lines of trees will have many times the beneficial effect in moderating storms, checking winds, or lessening cold that a single one can exercise. It would be well here to mention the method in which the most successful experiment in planting of this sort I am acquainted with in Ontario was carried out, as it is the easiest, and, if the time and temperature be rightly taken advantage of, the surest of all methods.

This plantation, or rather long line of trees, was obtained by taking young pines, partly from a wood, partly from a field. They were taken about six feet in height, and

a time chosen when, early in the spring after the ground had all thawed out, one night's frost had hardened it again to the depth of over an inch. A number of men were set at the work so as to take advantage of the then state of the ground, and with sharp spades a ring was cut around each tree nine inches or more from the stem, cutting through the frozen surface and going some inches deeper. On passing the spade further under in a partly horizontal direction, the round mass of earth and roots, bound together by the frost, was easily lifted, was carried to its appointed place and planted at once, losing but little of its adhering earth in the transit. Earth was then carefully filled in wherever a gap existed, and the tree left. Nearly eight hundred trees were so planted on that occasion, and so complete was the success of the method used that scarcely a dozen trees died. When I last saw the row of trees it was nearly fifty feet in height, forming a complete natural wall around all that part of the farm, and, as a matter of course, having an extremely beneficial effect both in mitigating the severity of the cold in winter, checking drying winds in summer, and in many ways encouraging growth in the fields it sheltered.

If Ontario had, crossing the country at reasonable intervals from east to west, many successive rows of evergreens, travelling in winter would be much easier, crops be much better, and what was grown would be procured, there is good reason to believe, at a much smaller cost than at present. It is, as I commenced by pointing out, a very great loss that the numerous young evergreens now found growing wild in so many pastures (for cattle will not, as all are aware, eat them down as they do others), should not be placed where they could be of such infinite value, instead of being, as is too often the case, burned up as so much rubbish whenever the field is needed for the plough.

And, finally, speaking of cattle, we should remember the very great advantage the shelter and shade of such tree lines will be to them. North of them they will throw a shade which will weaken grain for a few yards, but it will improve grass, and give a splendid resting place for cattle. We are, in future, in Ontario, to depend less on wheat, more on grass-growing and cattle-raising. For these last purposes, we can hardly have too many lines of trees.

THE PLANTATIONS ADVISABLE ON ONTARIO FARMS.

It will be noticed in another part of the report that many farmers and others have within the past year or two commenced to establish small plantations, ranging from a few hundred trees in a treble or quadruple line to a good few thousand. By next year, I trust to be able to visit and report on a number of these. The first year, as my readers are probably aware, a sapling is tolerably likely to grow; it is the second year which decides whether or no good root has been taken, so that it is as well to allow a little time to pass before judging of the state of these. What is satisfactory is to note that they have been started to a certain extent. Where the practice of planting once takes footing, many are certain to follow the example set. On many a piece of ground, now worthless, might be standing, in a few years, a compact grove of elm, hickory, ash, or such trees, from which every year after might well be culled a hundred dollars worth of timber. But this is not got by planting some straggling trees; they must be properly set and cared for. But for those who will do it, the money will be surer than wheat or cattle growing, if the statements of those who buy much lumber of this class yearly are to be believed.

The reasons, both climatic and economic, for planting such groves, are also elsewhere set forth; but a few words may be said here as to the part of the farm they should occupy, supposing the piece of ground to be planted to form a portion of one. In a late

examination, described elsewhere, of a considerable section of Ontario territory, the opinion was expressed by many that on a great number of farms there would exist some acres of ground worthless, or comparatively so, for other purposes, which might well be devoted for tree-planting.

It may be that there is a steep hillside. I could point out a hundred farms where there is such a hillside channelled with the washing rain, and white and poor from loss of vegetable matter. Now, when the land was forested, this was deep with rich humus, from which sprang upwards trees by the thousand, many of them gigantic in their growth. Centuries passed, the storms came and the rain poured down, but they never washed the rich earth from the hillside. The interlacing roots—the depth of vegetable matter absorbed it sponge-like, held it by the ton weight—on large surfaces by the hundred ton weight—and kept it till, when the dry valley needed it, it came forth gradually, from a million underground channels, to refresh the thirsty soil. Now, it is different—the trees on the hillside are gone, storms come, rain falls, but it rushes at once to the creek, the creek to the river, the river to the lake, the lake to the ocean. Then in the dry time which follows, the level land fails to receive the benefit it once had from the forested hill, the crop is poor, next year it may be poorer. Why will we fight against Nature? If, instead, we would but follow her methods, she would be our friend. We force her to be our enemy.

But now, as I said, this hillside—it might be said these thousand hillsides—are bare, barren, absolutely worthless. There is scarcely pasture there for a rabbit. Perhaps more—perhaps one or two sheep might occasionally pick a bit. Perhaps in the year a couple of dollars worth of mutton might be credited to the hill. That is all. Well, if by tree planting matters can be improved, we must cover the whole face of this hill with young trees, planting them far closer than we wish there ultimately to remain. Our object is now, first, not to grow trees, our object is to cover all this parched hillside from the sun's rays by the spreading leaves of little saplings, planted everywhere over the surface; second, to check the wasting away of the soil by interweaving all through and over it many millions of little roots. This can be done by getting ready all our miniature trees by some cool or damp day in spring or fall, if we are trying deciduous trees, or the beginning of June or August if evergreens, and going over the whole slope with spade or fork. Perhaps the digging fork is as good as any, but that depends on the state of the ground. Here I should like to mention it to those who may not know it that if you are digging in sticky ground, and your spade keeps getting covered with adhesive clay, if by any means you can have a pail of water near to plunge the spade into now and then it will greatly lighten the labour. Of course, I am now speaking of a hillside too steep to be ploughed. Well, all over this, as close as we can afford, we plant our small trees; and when the leaves are out, if we have luck, this whole hillside will be shaded and our young roots will take well underneath. Then as they grow and clog one another we should be at hand to take out those which are too many, taking them out, in fact, as fast as the leaves touch. Those we take out, being now transplanted trees, will have far better roots if they have taken well in the hillside, than forest trees, such as I am supposing we have put in, for every transplanting renders the roots more bunchy and fibrous and easier to plant, rendering the tree surer to take. Then you will, of course, not throw these away. If there be missed gaps in the hillside put them there. If not, all the better, but do not lose them; plant them somewhere else.

Now, when we get our hillside covered with a good growth of trees, two things will happen. In the first place there will be, owing to the mere presence of the trees, a moisture and richness in the adjacent land which was not before. It will grow you better and heavier grass; you may not unlikely get one and a-half or two tons to the acre instead of a half a ton, or a quarter, as I have seen many a time. Next, if there be a

slope of land below the hill—a field where you grow grain or what may be—it is certain that the moisture now detained among the tree roots will in dry weather flow to and moisten your field on the slope below. I need not say what this means. It will often double the crop.

Then, suppose, as we often see, we have a ravine or gully, an awkward place to plough, and as likely as not altogether abandoned to poor pasture and a few scraggy trees. If this be thoroughly planted with trees, in very many cases a long forgotten spring will begin to flow again from one of the banks, and in every case we shall have in valuable wood what was in very worthless grass. In many such cases, if the idea of close planting for timber be abandoned, and the trees left some dozen feet apart, we shall ultimately have water, shade, and some occasional grass for cattle, in short, a pleasant shady nook instead of a dry gully, fit for nothing but to show channelled clay, and impress the visitor or passer-by with the idea that so-and-so's a pretty "hard" farm. But even if this be the desire, let me suggest that all be closely planted at first, so that, as before mentioned, the trees may grow by the impetus of the shaded ground below them. They can always be thinned out, or, if they grow well, we can choose whether we will have close growing timbers or an open grove.

Or, say we have a field which has been cropped and re-cropped till it is hard and perhaps bakes red in the sun. This is an unpromising subject, but if it be in a situation fit to have in wood with consideration to the way the rest of your land lies, if you can afford time to summer-fallow this field, and in fall or spring, when soft, plant it thickly with young trees, ten to one they will grow and thrive. If we plant them pretty closely one way, and the other way leave room to run the cultivator between them, in a little while we shall have a quantity of valuable timber growing on many a field of the class I am thinking of, which of late, year in and year out, hardly gave in profit its taxes. And if, as often happens, this portion of land be the highest on the farm, which is likely to be the poorest, as having been washed by the rain for years, this upper portion being in wood will tend to keep moist and fertile in dry seasons the whole of the lower lying land. For as before explained, a wood on the summit retains the rain and gives it out as needed to the land below.

Or, if there be a piece of woods it is wished to preserve, which seems to be "drying out," there is no better way than, if a piece of land can be spared, to plant a broad belt of wood alongside it, which will both grow better by the shelter of the other and give it shelter in return. I know instances where farmers not owning the bush to the north and fearing its shelter might be lost to them, the owner thinking of clearing, have planted a belt of trees on their own land next the other, which are growing much better than they would in the open; while on the other hand, it is evident that the trees on the border of the old wood are doing better as well.

Wherever a creek runs thorough permanent meadows, whether the creek be perpetual or occasionally dry, much benefit may be expected to the meadow if a portion of the land highest up the bed of the stream be re-wooded. In this case those trees which love lower ground should be chosen, as the cedar, the soft maple, tamarack, black ash, box elder, etc., unless the upper part be high ground. I have no doubt, from frequent observation of the benefit of trees to adjacent grass, that twenty acres, five being thus re-wooded, would yield from the remaining fifteen very much more than the twenty had been in the habit of furnishing. Of all crops in summer, grass profits by the moisture which adjacent groves diffuse. I have seen timothy grass near woods, this year, nearly six feet in height, while out in the open, the soil being the same, it was nothing like as good either in height or weight of crop; it was not two feet high, and thin.

Many farmers are now either planting or preparing to plant broad strips of trees along whatever side of their farms they think most exposed. This is an excellent plan, for when the work is properly gone about, the portion of the field summer-fallowed or otherwise rendered mellow or workable, where necessary (for some soft lands need little preparation) a broad strip, say seven rods wide, can be planted in a short time, the young trees being procured and at hand. And if planted pretty closely, as previously recommended, they will thrive, with a little attention to stirring the soil for a year or two, beyond measure better than those standing separately. But I must caution my readers

also against another very common error. It is right to plant far too closely at first, but by no means right to leave them so. In the forest nature does the thinning by crowding out the weaker trees, but this is a slow and indiscriminate process. When the trees become too close by all means spare not to thin them out, neither neglect the proper time in which to do it. You will there, as before hinted, find plenty of young trees with excellent fibrous roots fit to plant elsewhere.

The reasons for planting, that humidity may be preserved and fertility consequently remain, are stated elsewhere. But apart from this, there is the great and certain profit which, in a few years, the timber obtained will realize. We all, or most of us, in the cleared districts of Ontario, can remember when, if we needed a stick of sixty foot rock elm or cedar for a barn sill, or a long basswood for a plate, or a number of balsam poles for rafters, we knew where to get them and generally had to pay nothing for them. Now, no matter how much we paid, in most districts we would not know where to get them at all. There are still a good many woods, but they are culled. Where could we build a ship of sound white oak now? On what lake or river? It would take, from what I have seen lately, a good deal of scraping together and culling in most parts. Where is there one of the old fashioned hickory studded woods? I know a place where I perfectly well remember choosing from half a hundred great trees which one I should chop a piece out of for an axe handle. I passed lately; the woods were gone, and the owner said he had "hearn tell there used to be slashin good hickory on the lot, but there wasn't none now." Well, in a few years, before we can grow them, very many sorts of hardwood are going to be very scarce here. We do not feel it so acutely yet; timber has been coming in from the outlying portions of Ontario, which supplied the wants of the older counties. But in these back districts are no such stores of hardwood as once the front possessed, nor anything like them. In ten years time a certain description of hardwood will be in great demand, and will bring a high price all through Ontario, and it is this very class of timber the small plantations on farms will produce, namely, second growth wood.

The trees in the original forest, standing here and there, offer no comparison, in regard either to the amount or quality of wood to be obtained, with those in an evenly set plantation. When we plant trees so as to shade the ground, each strives to rise above the other to the sunlight, and the consequence is, that in a properly arranged grove we shall not only have a rapidity of growth we never attain in single isolated trees, but we have also an entirely differently formed class of trees, and therefore an altogether different kind of timber. In the isolated tree, or the tree in rows by the fence, or the tree which has sprung up in openings of clear ground in a forest, we have a tree inclined to branch to the ground, and to inclose its trunk in branches all the way up. Such a tree, cut down, gives timber full of knots from end to end. It is tough and durable, but that is its whole value. It is not good for fuel, for though when once sawed and split it burns well, the labour of cutting it up often comes to more than its value. It is not good for use in building or manufacture, except sometimes as a mere squared beam, for it generally is, except perhaps a short length at the butt, quite destitute of clear timber. It is the opposite of that I am about to describe, namely, trees grown in a close plantation.

Here, if properly cared for, you will have thousands of fine, straight, tall stems. At first they will have lower branches, but the shade will kill these off when small, an operation in which the owner can assist, if he has time, cutting them close to the trunk, and as is always the case, the improved progress of the tree well repays the aid art has lent it. For instance, to give an idea of the principle, I know many forests where the young trees have been given a chance, free of cattle, to grow, and here you will see trees not yet six inches through, and fifty feet high, without a branch, pressing upwards to the sunlight above. On this principle, which always operates in the same way in forest or plantation, we can raise as many groves as we choose, which, after a few years, will have no branches but those in the leaf-roof high above, all the rest will be timber. I have seen millions of trees, planted four feet apart each way, and many of them twenty-five feet or more in height and eight inches at the base, before they needed either thinning or trimming. Let it be here again explained that they will do without either; nature will thin and prune; but these plantations were miles square. On the smaller ones, here recommended, art should aid, and the trees would be much better for it.

I need not say how many trees can thence be cut. Any reader can easily imagine for himself what multitudes of tree trunks can be successively taken from a few acres managed thus, and when we remember the varied woods which can be planted and easily grown in our climate, what does not suit in one place answering well in another—the white oak, white and black ash, rock and water elm, hard and soft maple, basswood, hickory, walnut, and many others, all soon to be very valuable—many of them so already—it will be seen that the plan of giving the waste portions of the farm to trees has no unprofitable tendency. “Give me,” said the head of one large waggon-making firm in Ontario, “one farm covered with hickory from six inches up, and it would be worth more than the whole yearly crop on some of our cleared but struggling townships.”

As stated in the first part of this article, many farmers have commenced these small plantations. There should not be a farm in Ontario without a good-sized one.

OSIER WILLOW CULTURE.

Many inquiries have come to the Washington Forestry Department in regard to methods of osier planting, showing that this branch of forestry, applicable to many soils, seemingly simple and promising quick returns, has attracted widespread attention. That Department has, consequently, issued the following instructions, which will be found valuable here, as the osier-work industry in all its branches has of late years received a considerable impetus, and many beautiful pieces of furniture are now being made from basket-work—chairs, tables, carriage bodies, and an infinity of other useful articles being now manufactured in basket-work. In old times houses, in England and elsewhere, were largely made of the wattled willow. The ancient chronicler, Hollingshead, seems rather inclined to regret their disuse as tending to effeminacy. “When our houses were of willow,” he says, “then we had oaken men, but now that our houses be of oak, many of our men have not only become willow, but some of them altogether straw.”

It should be premised that osier willow growing for profit is not so simple or easy and inexpensive an enterprise as might at first appear. The market for the material is the first point to be considered, and, in connection with this, the kinds that will grow successfully and profitably. So far it seems that the climate of the United States, in most parts, with its long, hot summers, is not very favourable to the finer growth of the osier rods, at least not of the European kinds, which, with one exception, are pronounced unsuitable, while American willows are not yet sufficiently tested to warrant their extensive employment as osier holts.

The importation of osier rods, formerly under a duty of 30, now of 25 per cent., *ad valorem*, amounts annually to over \$50,000 in value, while that of manufactured baskets and osier ware, under a duty of formerly 35, now 30 per cent., during the last five years has averaged \$243,185. To obtain the material thus imported, which cannot be less than 10,000 tons, we might well devote 6,000 to 10,000 acres agriculturally worthless soil, if we can so secure a desirable product.

Selection of Soil.—To make osier holts profitable, such soils should be selected as cannot otherwise be used to advantage. Very poor soils, however, should be avoided, unless there is a good market for inferior material.

The best soil is a fresh, black sand, but even a compact, heavy loam, and rich but sour meadow land, which produces the poorest quality of grass, is always equally acceptable.

Peaty soil, if it can be covered with a layer of sand or loam (from the drain ditches), will produce a good growth. The Caspian willow will thrive on poorest sand. Planted on the embankments of brooks, ponds, ditches, the osier will secure the embankment and yield a good profit besides. Never plant on soil likely to be covered with stagnant water in summer.

By making drains in such localities, however, good crops can be procured. Localities liable to late spring frosts should be avoided.

Cultivation of Soil.—Plough or spade the ground sixteen to twenty inches deep; deeper, if the sub-soil brought up would improve the ground (sand or loam below peat); less deeply if the soil is shallow and the sub-soil meagre. Spading offers the opportunity of burying the weedy material more effectively. Wet ground should be formed into raised beds of from thirty to fifty feet wide, leaving two-foot ditches, by which the water is quickly drained off.

The water level should be laid at least one and a-half feet deep. In spading care should be taken to bring the surface soil under, and the sub-soil on top. By this means the roots will be benefited by the vegetable mould of the surface soil, and the sub-soil at the surface will prevent the rapid running to weeds. For spring planting the soil must be prepared in fall or early winter, so that it may be pulverized by the frosts.

Choice of Varieties.—Out of upwards of 251 species of willows, and their endless number of varieties and bastards, only a limited number have been found of economic value, especially for osier purposes. While for European climates the best varieties have, by long experience and careful experiment, been established, we cannot yet speak authoritatively for this country, especially about the capabilities of our native willows.

Such an authority as Dr. C. L. Anderson, of Santa Cruz, Cal., states in a letter to the Department, "Our native California willows, especially those growing here at Santa Cruz and vicinity, answer very well for all purposes. Baskets, hoops, etc., are made from all the varieties that have the habit of growing along our streams. There is a difference, however.

"*Salix laevigata*, Bebb, (no common name) and its varieties, and *Salix lasiolepis*, var. *Bigelovii*, Bebb, (no common name), seem to be preferable. On wet prairies, from Illinois and Wisconsin westward, is found plentifully a variety (*gracilis*) of this species, the twigs of which are collected near Chicago by Germans, and sold to dealers in that city.

"*Salix cordata*, var. *vestita*, Anderson (Diamond willow)—Common clear across the continent; twigs stout; suitable for the heaviest kind of basket work; bronze or yellowish green, often bright red when exposed to much sunlight; not so tough and pliant as those of *S. Sericea* and *petiolaris*.

"These all grow rapidly and hardy, and the texture is sufficiently tough. There is a variety of *Salix lasiandra* that has not been sufficiently described. The branches are long, slender and drooping, and have the appearance of the weeping willow. This variety is well adapted to economic uses."

"Prof. M. S. Bebb, of Rockford, Ill., the American authority on willows, in a lengthy letter on the subject of economically useful varieties, after reciting his failures with European species and varieties, says: "My strong conviction is that success in osier growing throughout the corn belt east of the Rocky Mountains will only be attained by making good use of the plants adapted to the climatic conditions, and even then that the product will fall below the best European in quality. *Salix purpurea* in some of its forms most highly esteemed abroad for osiers, is checked also by the midsummer conditions, but not to so great an extent as the sorts above mentioned, and one from which you particularize, viz., *Salix purpurea pyramidalis*, I should regard as a hopeful subject. Of willows indigenous east of the Mississippi River, I would name the following as perhaps the most promising kinds for future trial:

"*Salix sericea* (common eastward), a bushy shrub six to ten feet high; branches reddish green or greenish, at length olive; twigs long, slender and very tough, yet extremely brittle for an inch or two at base.

Salix petiolaris (common westward), near akin to the former; habit quite similar; twigs usually yellow or tinged with crimson; not so brittle at base."

From correspondence so far had with practical osier growers in the east, the species most successfully grown in the North-eastern States, and seemingly too in Georgia, is the *Salix purpurea*, commonly called the red osier; but which of the several varieties this has not yet been established, probably *pyramidalis*. The red osiers are of German origin, and are considered the most useful, making numerous pliant, thin, slender, evenly-grown rods, without branches; especially adapted for binding and wattling purposes; growing well on a moist, but also drier, sand soil, less so on compact soils, but again excellently

on mucky soils. They are least affected by heat and cold, wet and dry. But compared with other kinds grown in Europe, their yields are somewhat inferior, giving a full crop only after the third or fourth year.

Altogether, vigorous growers are to be the most recommended; yet even on the best soils, with quick growing kinds, the growth diminishes after a few years.

In the selection of species it is not to be forgotten that, while they must be adapted to climate and soil, and be good and persistent producers, the kind of material furnished by them is to be kept in view, as different species and different varieties differ in this respect.

Planting for cuttings.—The best time for planting is the late fall, generally the end of October. For such planting the soil should be prepared in spring or early summer and left fallow. If the spading has been done in fall or early winter, the planting should be delayed till early spring.

The growth of the cuttings is the more assured the less advanced the spring growth. To retard early growth take the cuttings before the 1st of March and lay them in water. Take cuttings only from main shoots, and only from the lower half of these, because the tops would yield too weak material. The best length for cutting is about twelve inches; on compact, moist soils a length of ten inches will suffice, while on dry sand and peat soils fourteen to sixteen inches may be taken in order to get the larger number of roots in the first season, the number of roots being to some extent dependent on the length of the cutting underground. Place cuttings in the ground so that the tops are even with the surface, but on compact and caking soil, which would hinder the buds from pushing through, leave two or three buds above ground.

After the shoot is started it is well to draw the earth up to cover entire cutting, as many dangers beset the top when left free—injuries in cutting, from drying and insects. Take care to pack the soil closely around the whole length of the cutting. The practice of placing the cutting inclined is without rational foundation. Cuttings for planting are best taken during winter, when vegetation rests, and may be taken from three, two, or even one year old wood, if of good size.

The distance at which osiers are planted varies. Two considerations must be kept in view, the possibility of cultivating and working between the rows, and the desirability of shading the ground as closely as possible, which keeps the soil moist and free from weeds, and, to some extent, from insects. A distance of twenty inches for the rows and four inches in the row answers these purposes.

Cultivation.—In the first year this is best delayed until the middle of June, to avoid disturbing the small rootlets. When cultivating, first mainly subdue the weeds and hill up the soil around the cuttings; second and third weedings should be in August and September. Before winter sets in the plantation should be free from weeds. In the second and third year thorough cultivation is required. The first cultivation should now be given as soon as the frost is out of the ground. All cultivation must be shallow, not more than two inches deep, so as not to injure the roots.

Manuring.—There is no doubt that by the use of manure or compost the yield can be largely increased; but it is mostly too expensive, as the material would have to be carried into the plantation by hand.

As to fertilizers, mucky or peaty soils should not receive an increase of nitrogenous matter, though this is desirable, however, on poor sands and meagre loams.

Phosphoric acid fertilizers improve the quality of osiers; the cheap phosphorites which are readily assimilated are particularly desirable. Potash, forming a large part of the constituents of willows, is especially effective.

Fertilizers are best applied during rainy weather and early in the season, as soon as the rods have been cut.

Insects.—The experience that extensive plantations of one kind increase the number of their enemies holds good for osier holts. Most of the injurious insects are beetles and their larvæ. The former let themselves drop to the ground from their host as soon as this is touched. This habit allows the use of apparatus to catch the beetles in quantity, which should be done as early in spring as possible.

The application of quick-lime, of hellebore and of Paris green has been found successful by Mr. T. Gleason, an extensive osiergrower in Syracuse, N. Y.

The red osier (*Salix purpurea*) is especially liable to the attack of the gall wasp *Cecidomyia salicis*; but its spread can be avoided by cutting and burning all injected rods.

Harvest.—Osiers should be cut the first year, even if no valuable material can be got. If the cutting is delayed until the second year, branching takes place, and less valuable material is obtained. They should also be cut in the second and third years, but should be left uncut the fourth year to grow to hoop-poles in two to four years. If there be no sufficient market for hoop-poles the yearly cutting may be continued until the growth becomes too slim, which is generally in ten to fifteen years. Cutting of rods should be done during winter, from November 1st to March 1st; cut as near the ground as possible.

Keep the rods in running water, standing upright, four inches of the butt under water, until they peel easily.

Hand-peeled stock is preferred and brings a higher price than steam-peeled rods, the price last year was from six to eight cents per pound. In an average of five years the yield may be from 90 to 130 pounds per 100 stocks. Mr. I. C. Plant, of Macon, Ga., reports one and one-half tons from a three years' plantation, planted fifteen inches in the rows and five feet apart.

PRESERVATION OF BIRDS.

While engaged in proposing the preservation of trees, and desirous that every farm should have its grove for fuel and timber, and its wind-breaks for shelter, there is another point which should not be overlooked. It was formerly the mistaken idea of preserving a forest that we were to leave the large trees and cut down the undergrowth. It is now known that this is a sure way to defeat the object, and that to preserve a forest you must allow the young trees to spring up in all directions, both to keep the ground in good forest condition and to furnish the means of continuance of the wood. This, if generally done, would afford a shelter in which birds might endure our winter, and wind-breaks of evergreen would afford them an additional chance. The subject of preservation of bird and forest are so intimately connected, that a few words may well be said here thereon.

We are deeply interested in the preservation of these tenants of the air. They are sources of both pleasure and advantage. They protect our food; they please the eye; they charm the ear; they may even instruct the mind.

I need not here repeat how various wise governments, in their zeal for the preservation of some few ears of corn, some few small fruits, supposed to be feloniously appropriated by the birds, ordered the extirpation of these malefactors; and how in consequence insect plagues well-nigh stripped every ear from the fields and every leaf from their trees, till they were forced at great expense to import fresh detachments of their feathered allies. In fact the subject is better understood than it was a few years since, and that being the case, it is astonishing that so many useful birds are yearly shot.

Birds have, as I have remarked, many other claims on our consideration besides their value as insect destroyers. Their beauty, their lively movements and graceful flight, their cheering song, give additional charm to every landscape, and form one of the greatest pleasures of rural life. They are too, in their own way, preachers and moralists, whose lives deliver sermons and homilies. Their whole existence is a perpetual lesson of industry, of gratitude, of contentment. Surrounded by perils; in danger from want, from cold, from tempest, from their own natural enemies, and from those who should be their friends—and fully conscious of all these causes for fear—still, with spirit undepressed, they urge their daily labours; still their joyful carol rings boldly through the air. It is strange that, with so many claims upon our kindness and sympathy, we should find any gratification in injuring them. Why should we destroy creatures whose death can in no possible way benefit us, and whose lives constantly yield us profit and afford us pleasure?

Farmers, especially, who protect birds, may confidently expect repayment. They will return yearly in increased numbers to the very fields where they have found safety, to guard from the creeping things of the earth, from the winged plagues of the air, the growing crops of their benefactors. No creatures are more quickly sensible, more thoroughly appreciative of kindness.

There are, as we all know, certain birds which make especial war on the products of the orchard, or the young sprouts of vegetables in the garden, and others which certainly devour the seed grain. These, however, are of a few varieties, while the number of insect-eating birds is large. A pair of robins, it has been calculated by careful observers, will in a season eat 32,000 and more grubs and larvæ, besides grown insects. Nearly all the woodpeckers are constantly engaged in the pursuit of insects and their eggs. Certainly, while it is necessary to destroy the injurious birds wherever possible, it is equally advisable to refrain from injuring those which are so beneficial to the country.

Here it may be said that many authorities concur that the English sparrows should be destroyed by every means. In America much information has been obtained in the various States respecting them, and the Washington report says :

"The true name of this bird is the house sparrow. The name "English sparrow" is a misnomer, as the species is not confined to England, but is common to nearly the whole of Europe. The fact that most of these birds brought to America came from England explains the origin of the misleading name by which they are now so widely known."

Dr. Warren, State Ornithologist of Pennsylvania, M.A., writes, "Our native birds have rapidly and steadily diminished in numbers since the sparrows came. Former plentiful residents are rare." The birds which have suffered most it is said from the sparrows are the robin, catkin, bluebird, wren, song sparrow, chipping sparrow, yellowbird and oriole. This is the American statement; but others have been greatly lessened in number here. The swallow and the night-hawk, both insectivorous, are not as plentiful by seven-eighths; indeed it is doubtful if there is one tenth as many as formerly. The Washington ornithologist says:—"In addition to the indirect injury thus brought about by depriving our gardens and orchards of the protection afforded by our native insectivorous birds, the sparrows cause a positive and direct loss to our agricultural industries amounting to the aggregate of not less than several millions of dollars per annum. The ravages of the sparrow affect almost every crop produced by the farmer, fruit-grower and truck gardener, and extend over the entire year. Indeed, it is safe to say that it exerts a more marked effect upon the agricultural interests of the country than any other species of bird; and its unprecedented increase and spread, taken in connection with the extent of its ravages in certain districts, may be regarded with grave apprehension. In the early spring it prevents the growth of a vast quantity of fruit by eating the germs from the fruit buds of trees, bushes, and vines, of which the peach, pear, plum, cherry, apple, apricot, currant and grape suffer the most. Complaints of heavy damage done the grape crop of 1886, has reached here from twenty-five States." In Australia, in the evidence published by the government, we read that "in the short space of ten days the sparrows took a ton and a-half of grapes from the vineyard of John Chambers, Esq., of South Richland."

In England it is likewise being complained of. Miss Ormerod, Entomologist to the Royal Agricultural Society of England, in her last report states that the sparrows drive off swallows and martins, thus permitting a great increase in flies and insects destructive in the orchard. Mr. Gurney, the well known British ornithologist, says, "I think they do enough harm, to warrant everybody in destroying them. One-fifth of good to four-fifths of harm is about what they do, take the country all over, though at certain times and places they do nothing but harm."

It is evident that the regulations which are now proposed, appointing people to kill these house sparrows and making it a punishable offence to feed or encourage them, are wise provisions. The chief evil done by these birds is that, not being properly tenants of the grove themselves, they kill the birds which are; and not themselves largely insect-destroying, drive away the birds which destroy very many insects indeed. It is these last, and there are many of them, the preservation of which I would in every way advocate. If we provide shelter in the way of under-growth in our forest for these birds,

and also grown, which we should grow for other purposes, many a wind-break here and there, we shall have our roads and fields brilliant and vocal with the most beautiful and pleasing objects in animated life, the feathered songsters of the grove. As it is, partly that the sparrows have driven them away, but much more often that the farmers' sons have shot them, you might, for all the birds you see, as well travel through a desert as along many Ontario concessions.

If, when a child is young, the father point out to him the beauty and usefulness of birds, and direct him to admire their graceful movements and pleasing song, it will produce a very different effect on his mind and future character than if he is encouraged to throw stones at them. The latter course is too often followed and the results are evident. It is a common practice for the young men of many townships to hold shooting matches, in which the country is traversed by scores of guns and the prize gained by the number killed, so that all life seems utterly swept and banished from our woods and fields. In these hunts everything goes, not a squirrel or bird escapes, and I have no doubt whatever that very much of the injury committed by insects on our fields and orchards is directly owing to the vast number of woodpeckers and other well known insectivorous birds killed in these expeditions, and by single hunters afterwards, whose minds have been so trained that the death of harmless birds can afford them pleasure.

There is an excuse in older countries, where game is strictly preserved, for objections to the injury done by great numbers of birds kept in the immediate vicinity of the fields, but there is none here. The few squirrels, partridges, or pigeons now left can do but little harm, while many birds—the robin, most of the woodpeckers, and others—do a great deal of good. Nothing is more pleasing to the rightly educated mind than the observation of these, and the half companionship which, when well treated, they bestow. Let us preserve their lives; they will in return amuse and assist ours.

EVERGREEN HEDGES.

There is nothing so beautiful about a farm, especially in winter, as some extensive lines of evergreen hedges. It is now, indeed, the custom to substitute the open wire fence for all description of closed fences to prevent the drifting of snow. This does not, however, appear to be so much thought of in other countries, for all through Illinois, Iowa and Kansas, last year, I noticed them busily engaged in substituting the hedge for the wire fence; and, throughout the prairies the long hedge rows are now the chief relieving features of the landscape. The following statement is by Mr. Warder, the best authority on this subject:—

Beautiful hedges may be made by planting rows of almost any of the common thick-growing evergreen trees and shrubs. The Norway spruce has been applied in this way; the common cedar is very efficacious, and much used for producing a shelter-hedge, where a quick, permanent and effective wind-screen is wanted; but is liable to grow thin at the bottom. The American *arbor vitæ* and the hemlock are admirable where a neatly trimmed garden or lawn evergreen hedge is desired—one that can be kept within bounds.

Those who expect good crops and intend to produce them, are aware of the great importance of a thorough preparation of the soil. So with the hedge, its success will depend, in a great measure upon the manner in which the ground has been prepared for its reception. Deep ploughing and even sub-soiling has been highly recommended. In wild uncultivated lands, the sod should have been broken up some months previously, so as to become mellow, and then deeply stirred in the spring, and freshly harrowed before planting, which should be done just as the plants are ready to start.

The distance from plant to plant becomes now a matter of great importance. My cedars at two years old were set three feet apart, but so perfectly are the branches united,

it would be difficult to tell where the stems of these plants emerge from the ground, in a hedge of three years growth. I should not desire to plant the hemlock or the American *abor vite* any closer than the cedars.

Trimming.—The general rules, already laid down, will apply here; except that the evergreens must be treated as a completed hedge from the first. There is here no cutting down to the ground to produce lateral branches; they are already provided in abundance in the young plants. We may, after planting, remove the tops of some of the tallest, to bring all to the same level, and many gardeners using tall plants, cut-in the tops severely. The trimming must be conducted on the principles previously advocated, so as to preserve the pyramidal shape with the greatest exactness; no perpendicular walls, no flat tops in the evergreen hedge should ever be allowed; the two sides should meet in a middle line.

The cutting or clipping may be done with the garden shears, by which all protruding sprays are removed to the proper surface of the hedge; which should be kept even and regular as possible. This process must be performed from time to time during the season of growth, or at its close, more or less frequently, as the plants are young and vigorous, or older, and have reached their mature state; in the latter case, they will require very little clipping.

While pruning the hedge, care must be taken to preserve the upper line regular and even, as this will contribute to the beauty of the whole affair, and any deviations from it will sadly detract from the appearance of finish and completeness which would characterize the evergreen hedge.

James Busby, who travelled extensively in Spain and France for the sake of investigating the culture of the grape, observes that one great cause of the low state of agriculture in the former country was the want of inclosures to protect the growing crops. Vineyards and gardens alone were allowed to be inclosed. He describes the hedges of Andalusia as being made very readily by planting the prickly pear—*Cactus*—and the Alve—*Agave*. The former makes a fence in two years, which is said to last for forty years; and if cared for, cactus hedges might be perennial. He says it is not possible to imagine a more effectual fence, or one more easily planted and kept in order. The only objection is, that they sometimes occupy too much space, and that the trimmings are so tenacious of life, that they will live even if thrown together on a dry spot of ground. This difficulty could be obviated, and the land benefited by composting these trimmings with lime. The Alve hedge is also much used in Spain, but inferior to the cactus, because the plants die when they have flowered.

IMPORTANCE OF A SUPPLY OF WOOD.

Nothing is more important to the people of Ontario than the continuance of a quantity of wood, grown in their own borders, sufficient to supply the demands of their own population. It is idle to rely for this on the forests in the rear. They do not contain it. There is much pine and plenty of hemlock, and many other woods, birch, for instance, in great plenty; but for fair qualities of hickory, walnut, white ash, white oak, and such, if we want them we must grow them. In this article, among other points bearing on the case, it is endeavoured to sketch out the different uses for which our great army of workmen are constantly drawing supplies from our forests.

Every one who has studied the subject, and observed how nations seem actually to have flourished or declined in proportion, as they possessed and used large areas of well-timbered land, is fully aware of the importance of this class of resource. Some, however, who have not paid much attention to the matter, are apt to believe that other materials, such as iron, are now so much used in many large structures, such as bridges, ships, and

so on, that wood will not in future be so vital a necessity in the constructive arts. I remember being told by a lumberman that it was no great matter if the forests went. "We'll find a substitute for wood," said he; "why, they're making sawdust into wood now." I did not ask him whence, if wood disappeared, he would get his sawdust.

But the fact is that, as in many other matters, the fresh material introduced only creates a greater demand for the old. When railroads were commenced, every one lamented the certain decay it would cause in horse breeding. Now we know that there are more horses bred than ever, the number superseded on the roads being more than made up by the great additional supply of these animals required in the cities and on the farms. Railroads have, indeed, made it possible for many to use coal instead of, and as cheaply as wood; but these roads themselves are vast wood consumers. Numbers of them still use wood for fuel, and even in the article of railway ties alone, North America has used, at the common rate of nearly three thousand ties a mile, four hundred million of ties, besides all the other wood required in the construction of cars and buildings, for which large amounts are required. These ties—all the 400,000,000—must be replaced every ten years, too. The amount of railroads largely increases, and that, therefore, much more wood will be yearly needed for these purposes. At present, by the calculation of Mr. Sargent, the chief authority in the States on these matters, the number of ties used each year now, in construction and repairs of railroads, is about sixty millions. Each year about ten thousand miles of new railroads are built; some years in the States there are less, but adding Canada and Mexico that will always be at least, the average. So that we may say, before long, there will be drawn from our forests—what are left of them—a hundred million of ties yearly. Now let us see how these are made. If large trees were taken—mature trees—trees which ought to be cut down, (for it is of no use to keep a tree standing when mature; it should be cut, and another, if any sort of decent forestry were maintained, should be ready to take its place), it would not be of so much consequence. But that is not the way these ties are taken.

The way is, choose a fine young tree about ten or twelve inches through, ten feet from the ground; that is from trees which twenty or thirty years ago escaped destruction by fire or browsing animals, and which if suffered to grow, would in years to come, afford immense quantities of valuable timber. How much do they afford now? Two ties each, that is generally all, for they are not even halved by the saw-mill, no; the tree is cut down, flatted with the axe on each side, cut in two lengths, the top left lying to create or help a forest fire, the two little flatted pieces of timber dragged off by the oxen, and the work is done. A fine young tree is lost; that is to say, in every year there are now thirty millions, and will soon be fifty millions of healthy, vigorous, young trees cut down and destroyed, (for we can hardly say used) for railway ties. It is a most serious drain upon our forest resources, and should cause much doubt as to the ability to supply it in the future, especially, as the same authority remarks, there are now, in every part of the country, fewer seedling trees valuable for ties than when the trees cut for this purpose first started to grow.

Let us notice the article of charcoal. A writer of eminence, Mr. Fuller, speaking of this, says: "It is only a little more than a century since coke was first employed for smelting iron ores. The introduction of this fuel to take the place of charcoal, it was thought, would save the forests of the world from destruction by the charcoal burners; yet, while it has done much towards making it possible to produce sufficient iron to meet the great and always increasing demand, it has not superseded charcoal, and there is probably more charcoal used to-day than at the time coke was first employed in a smelting furnace. Charcoal is still used in furnaces and forges, and there are several establishments in this country that use annually over five millions of bushels each, and a score of others that consume from twenty to twenty-five hundred thousand bushels."

"Notwithstanding," the same writer continues, "the number of substitutes that are employed, the demand and consumption of wood appears to increase, and to-day there is probably more wood used in making boxes of various kinds than there was in the construction of buildings of all kinds in this country seventy-five years ago. Furthermore, no kind or quality of timber appears to escape the insatiate demands of the artisan of the

period, and he not only finds ready uses for the large and the small, the hardest, toughest and most durable, but he also finds excellent use for the soft and spongy, this being preferable for grinding up into pulp for making paper."

With reference to the amount of lumber used for boxes, it is interesting to note that in certain quarters it has lately been sagely observed that there need be no such fear of the pine forests vanishing, since along the Atlantic coasts a young growth of white pine is springing up, and yielding some millions of feet per annum. Unluckily for my confidence in these reports, I have lately been through many of these seaside forests myself, and find that as fast as it grows, the whole is taken, so far, for boxes alone, the tree being cut when it will give seven or eight inches wide of boards. This is after about 30 years' growth; sometimes planted—often merely sown—on the meadow, very thin poor meadow, too, down there.

"It is idle," says the same authority, "to talk of our natural forests furnishing a supply of wood for the future use of our people. Even with the most careful management and economy in preventing waste, there must soon come a time of great scarcity of all kinds of wood. With an increase in population, there must soon follow a correspondingly increased demand, because experience has shown that whenever any other material has been substituted for wood, it merely releases a certain amount which at once finds other channels or markets. No matter in what direction we turn, the fact meets us, that the best and most reliable forests of the United States are fast disappearing, and the sooner we commence as a nation to economize in the use of wood of all kinds, and preserve the forests now existing, as well as commence planting new ones, the better it will be for the present as well as future generations."

It will be well here, if we consider in how many ways the material of our forests is being reduced. In Ontario alone, in all directions, the artisan continually despatches, so to speak, his messengers into the forest, continually draws thence heavy supplies of timber, which, considering also the fact that this is done without the slightest idea of leaving the forest in a condition to yield, in successive years, as much perpetually, may well excite the liveliest apprehensions as to our future supply of wood for innumerable purposes. In Europe, the forester cuts down his trees by the thousand, but whether of pine, spruce or hardwood, he cuts them from a forest which is definitely and decidedly planned out, so that this year a certain amount is to be cut, next year another; and all the while in other parts are other trees coming on in growth, and in readiness to fill the place, in future, of those now cut. Then, as soon as those now cut leave their place bare to the sun and sky, means are taken that either by seed or by planting young trees, new plantations will arise. But here it is, so far, but to go into the wood, cut down all trees fit for the purpose, draw away their trunks, and leave the forest, perhaps to be cleared for farms, perhaps to remain till, a few years hence, another wood-seeker shall enter and take the few valuable stems not sufficiently grown to-day. Then the forest all remains, not good for timber, of no further use to the lumberman, and in a few years the farmer will cut all down, and grow crops of grain where, with care, crops of timber far more valuable might have flourished. It is the history of many a forest in Ontario. But, generally speaking, part of the evil is thus occasioned: cattle have been let in, all the good young oaks, ashes, hickories, maples, and so on, eaten down, and when reduced by culling, there seemed little hope of good timber. But this has been urged elsewhere.

Let us here notice a few of the materials which, in Ontario, we are perpetually drawing from the forest. In oak we use white oak, when we can get it, for all ornamental church work, sills, stringers and other framework of cars, sometimes their floors; for waggons and carriages, many parts of buildings, sleigh-runners, pianos and organs. White oak would be of much more general use but for its scarcity. An inferior kind of grey oak is largely sent into market as white oak now. Red oak too, is used for many of these purposes; it is not, however, nearly so strong or durable as white. It can often be known by its porosity; you can blow through an inch of red oak, not through good white.

Maple is largely used for horse-rake axles, frames of binders, and other agricultural implements; chairs, bedsteads and an infinity of cabinet work, tool handles, buildings, and so on. The beautiful bird's eye maple is largely used for ornamental work, such as

pannelling. In furniture making, too, soft maple is largely used. This, in the old forest days, was ever the favourite wood for ox-yokes. It was soft, smooth, and galled less than any other wood the rough necks of the strong beasts that carried it, while for toughness it seemed equal to any.

The white ash is a very valuable wood in Ontario work. In carriage work it gives us tongues and neck-yokes, large, broad spokes, and other parts of carriage building. It is also admirably adapted, by its beautiful grain and great durability, for the wainscoting and general internal finishing of first-class houses. It is the best material for oars, and it is a favourite wood with coopers.

Black ash is used for the same descriptions of house work, and for another for which it is peculiarly fitted, the tops and rims of pianos. It is also used in fencing, barrel-hoops, cabinet making, and the manufacture of baskets.

The Canadian butternut is a very beautiful and durable wood, is remarkably well fitted for and much used in bank and office fittings, doors, blinds, wainscoting for highly finished houses, car building, inside finishing generally, and cabinet making.

Cherry is also largely used in Ontario for bank and office fittings, doors, blinds and wainscoting for highly finished houses, upright piano cases, tables and cabinet work. It is a favourite wood for wardrobes and for the fitting up of bath-rooms, and is frequently used in car-building, as it has an excellent appearance and is cheaper than walnut.

Cedar is procured for many purposes. We have no other wood which endures so long without rotting the contact of the ground. It is therefore much in demand for posts, and it is now becoming the fashion to smooth and carve the cedar post itself instead of casing it outwardly with pine as has long been done. It is much used as lining for wardrobes to prevent moths, in which it is generally of effective service, though the Red Florida cedar is the true one for this purpose. For boat-building too, it is largely used, as well as for railway ties and shingles.

The Canadian hemlock, in many parts of Ontario where pine is scarce, largely takes the place of that valuable wood. It is not so easily worked, the knots being very apt to spoil the edged tools of the workman, and the splinters to annoy his fingers. It checks and cracks with the sun too, far more than pine. It has its virtues, however, among which are that it is almost rat-proof and will hold a nail as perhaps no other wood will. Its bark, as well as that of the oak, is largely used for tanning.

The birch is, for much interior and ornamental work, next in value to cherry, that is to say, in bannisters, newels, rails, office fixtures and cabinet work. It has a peculiar value for the runners or slides of elevators and for veneers. The thin, perforated seats of wooden chairs are made of a treble thickness of birch curiously glued together.

Hickory is used for spokes, agricultural implements, viz., threshing machines, reapers, mowers, hay rakes, straw cutters, etc., double-trees and whiffle-trees. It is valuable for all descriptions of handles.

Shell-bark hickory is mainly used for rims and shafts for buggies, light poles, etc.

Rock elm is used for felloes, cutter-runners, much waggon and carriage work, binders and other agricultural implements, veneering, chairs and barrel work. It makes excellent barn sills.

Soft Elm is of value for cutter reaves, arm pieces, toboggans, veneering, chairs and tables, and cabinet work, in which it has much taken the place of basswood.

Basswood finds a place in agricultural implements, carriage building, such as carriage bodies, panels, buggy bodies and waggon boxes; flooring and sheeting in houses, barrel work, cheese boxes, legs and lyres for pianos, furniture, common chairs and tables and many other purposes.

The uses of pine are well known. There is hardly an industry in which it is not used; in many it is the chief material. It has been said of late, referring to the probable exhaustion of this valuable wood, that the sudden stoppage of its supply would create a greater panic than the suspension of half the banks in Christendom.

Chestnut is wrought here for pianos and organs, elevator manufacturing, wainscoting and general internal furnishing, and car work. It is also valuable for posts and fencing.

Walnut is valuable in bank and office fittings, wainscoting, doors, blinds, etc., in finely finished houses; car building, panelling, elevators, cabinet work, furniture, pianos and organs. Walnut would be used for many other purposes now fulfilled by other wood, had it not, through gross recklessness, become very scarce.

Tamarac is worked in Ontario for boat and car building; and whitewood for car building, pianos and organs, furniture and carriage building, etc.

We have workmen in many thousands here, and there are such by the million in other parts of North America, busily engaged the year round in exhausting the remaining supply of these valuable woods. There are but very few engaged in planting trees to replace them. It is a reflection not often made, but perfectly well founded, that much of the increased expense of living to-day is owing to the constantly increasing price of lumber, which in different woods and grades has of late years quadrupled. There is little doubt that in twenty years all kinds will be very much enhanced in price, and some quite out of the market, being virtually exhausted. These facts point one way, the way often suggested, that we should plant more trees. There will be more money in this—more solid gains—than in anything else.

SUGGESTIONS ON ENCOURAGEMENT TO TREE PLANTING.

What was noticed especially, in the tour mentioned, was that farmers, while fully admitting the value of trees, regretting that so many forests had been cleared, and remarking that the country was absolutely drying up for want of more woods, yet, when they came to speak of lines of trees on their own grounds, often seemed to grudge the little strip which, on the north or west of a windbreak, would have its crop weakened by the shade, which, for ten or twenty feet, would fall on it. It appeared as if, in too many cases, the farmer would be delighted that his neighbour should grow trees, while he himself would clear every foot, and put all in crop. It must be remarked that these were isolated instances. Many were fully aware of the advantages of trees, were planting them by the hundred, and never thought of grudging them space. But with reference to the general community, it seems that, if some inducement could be given to plant trees, it would be no more than what is, in the circumstances of the case, necessary. We are, so far, a community of tree destroyers. It is not natural that we should, all at once, change to a nation of tree planters. But time flies; we should plant now if ever. A few years and there will be hardly a stick of good, solid, young timber to be had. Therefore this suggestion is made—that young trees, of good kind and properly ready for the field, should be placed in numbers in reach of every farmer in Ontario. Thousands might not accept them, but hundreds would. We should have numerous plantations of valuable trees. That would be the main point, and the government or the parliament which secures it will have earned the gratitude, not only of Ontario, but of Canada, and for the sake of example, of all North America.

In a close examination of two sections of the country in Ontario, one north and one south, in which opinions were obtained from and the farms observed of nearly two hundred farmers, as fully reported previously in these pages, it was very evident that the cause of forestry was making progress, and exactly in proportion to, and to a great extent in consequence of, the interest taken by the press here and abroad in the matter, and the various governmental publications circulated thereon. Even in the same

township, in some cases, this was very evident, and when a section was approached where the inhabitants were less intelligent and cultivated—where, in fact, they read less—there tree planting was hardly practised or even commenced. On the other hand, where the farmer was abreast with the times, and his parlour table well supplied with books and newspapers, he had frequently already planted a large number of trees, was generally making arrangements to give his farm the benefit of complete shelter by a long row of evergreens or others, and, in many cases, was planning the formation of a broad strip of plantation along the most exposed side of his farm.

There is good reason, no doubt, to believe that the agitation on this subject has been, at least throughout Ontario, of great benefit, and is giving an impetus to tree planting which otherwise it would by no means have received, besides doing much to procure the preservation of many bodies of standing timber which would otherwise, to the great climatic and other loss of the country, probably have been cut down. A great part of the country, too, it is to be remembered, is yet in the hands of those whose life has been spent in clearing the land and getting out of the trees, and to change their efforts in a direction quite opposite is sometimes difficult, though there is many an ardent tree chopper of former days who is an enthusiastic tree-planter now. And though, in many cases, it is otherwise, yet everywhere the younger generation, now observant and often studious, and soon destined to have complete charge of affairs themselves, are likely to replace much of what their fathers destroyed, and by a better timber, since a well planted second growth will be much more permanent, and in process of time much more valuable, than the original forest.

It is evident, however, that this will, at the present rate of progress, be a work of time. Emulation will doubtless do much; the farmer who observes the progress of his neighbour's trees and their value to his farm will be incited to imitation and will probably plant largely on his own grounds. But fifteen or twenty years elapse before a windbreak is of height to be largely serviceable, and the time is too valuable—the interest at stake too large, to admit of delay being allowed, if it can possibly be avoided. A means of giving a much greater stimulus to the work has been suggested, and will now be described.

Many land owners, and of them some of the most practical tree planters in their respective townships, state that a great obstacle would be overcome if a supply of young trees were always available, it being difficult to go into a forest, though it might be full of young saplings, and procure such trees as were really valuable, and of a size and spread of root likely to live in their new surroundings. The forest tree has grown in the shade, and the hot sun of the open is not friendly to its tender bark, while, on the other hand, though it has often been remarked that they should be taken from near the outskirts of the bush, it is often a matter of considerable loss of time to procure them there, a trouble much enhanced if cattle have been allowed entrance into the woods, as they at once proceed to destroy the very class of saplings most valuable for planting. Then—and this is one of the greatest objections to the bush procured sapling—the roots are few and spreading, running far over the surface of the forest ground, so that only a small part of the root can be secured. On the contrary, the nursery-grown sapling, transplanted purposely several times, obtains each time a better and more fibrous root, so that when placed in the field success in growth is far more certain. For these reasons I have known many persons, in planting trees, rather purchase from a nursery than take such as were to be had free from the field or forest.

What is suggested is that a large public nursery should be established, where trees of all sorts should be grown from seed, transplanted frequently till good roots were secured, and then given free to those who would undertake to plant and take care of them on their farms. It would be necessary to plan this in a sheltered portion of Ontario, where easily worked soil is cheaply procurable, such as the land at the mouth of the Don, or in the districts near Niagara or Windsor. Three or four men employed during the season could grow, care for, and send away millions of trees—trees, too, which would be

all likely to grow and flourish. Those receiving the saplings would, no doubt, be glad to pay the freight, which would generally be no large amount. It is not at all doubtful that by this means, every year, large numbers of trees would be planted throughout Ontario. At present, under the tree planting Act, government and the township pay twenty-five cents bonus on each tree surviving three years. There is every reason to believe that every twenty-five cents expended under the other plan would establish fifty trees.

Under it, the great advantage gained would be as follows:—Farmers are often willing to spare land for a plantation, say a wide belt of trees, or enough to fill some spare piece of land not fit for much else. They can summer fallow this, or prepare spots in it if it be broken land, and would often do it. If they could at once procure nursery trees enough to cover this sufficiently close to keep the ground shaded, the operation would be ten to one a success. If they have to trust to the straggling rooted saplings of the wood, it is not at all so certain a one. The plan would certainly multiply many times the number of trees now planted yearly in Ontario, always supposing that men of sufficient ability managed the work.

Such nurseries are common in other countries. In Prussia, in 1884, the government distributed free 25,000,000 of seedlings. Last year Bohemia distributed nearly 5,000,000, of which about half a million were deciduous and the rest coniferous. Next year twice that number will be given away by that government. Styria is making a similar distribution. Australia has in the last few years distributed \$8,000 worth of trees, each costing about one and a-half cents. There is, probably, no other plan of assistance so cheap, nor, if properly managed, any other so effective.

CONSUMPTION OF WOOD FOR RAILROAD CONSTRUCTION.

One of the chief demands now continually made on the forests, as mentioned elsewhere, is that for the ties for new railroads and the repairs of old. This demand is of the most injurious nature to a forest, as it takes the young tree, and but little of it, leaving most to rot in the woods, or excite forest fires. In no long time there will be difficulty in finding forests whence to draw these supplies. What I should like to call my readers' attention to is the fact that railroads in Kansas and elsewhere, as described fully in my last year's report, are planting miles square of young trees for this very purpose. This was begun eight years since, and they have many young trees of size for ties now. These may now be cut, not to the injury, but to the benefit of the plantation, since they have all been planted four feet apart, each way, and the intermediate trees had now better go, as they are crowding. In Ontario, there is nothing to hinder anyone, in a few years, drawing thousands of dollars from a few acres planted for this purpose with well chosen trees.

A large number of circulars have been addressed from Washington to the various railroad companies of the States, numbering nearly 300, for the purpose of ascertaining the extent to which the forests are drawn upon in the construction of the roads, the kinds of trees used for railroad ties, the duration of different kinds of timber used for this purpose, the means taken to increase their durability, and other facts relative to the subject.

Reports have been received from companies owning or managing 70,880 miles of road, or about sixty-three per cent. of the whole. Assuming the present length of railroad track to be 112,000 miles, the average distance apart at which ties are placed is three feet, requiring 2,640 ties for each mile, or for the existing length of roads 295,680,000.

The railway companies almost invariably require, in building and maintaining their tracks, young and growing trees, such as are large enough only to make one tie to each cut. Trees of this size will not average more than two cuts each ; consequently the construction of our existing roads has taken 147,840,000 trees. Their wood lands, as they are, will not furnish more than 100 ties to the acre. Their roads, therefore, have taken the trees growing on 2,956,800 acres of ground, or a tract of land nearly as large as the State of Connecticut.

The average duration of ties, as given by the returns, is seven years. To maintain the roads therefore, one-seventh of the original number of ties must be supplied every year, or 42,240,000, or the product of 422,400 acres. In determining the actual demand of the railroad companies upon the forests for construction purposes no account has been made for the annual increase of the roads. It ought, also, to be considered that the roads take the trees just at the period when they are about to make their most valuable growth, as it is well known that most trees after the age of thirty years make a much greater proportionate growth from year to year than in their earlier stage, and their wood becomes also more valuable for most purposes. For instance a tree measuring sixteen inches in diameter will produce double the amount of sawed lumber that can be cut from a tree measuring twelve inches.

The annual revenue from the growth of an oak tree of the species commonly used in ship-building has been very carefully determined from the means of a great many records in France, and is as follows :

	Francs.	Centimes.
Tree 50 years old..... per annum.	0	10
Tree 100 years old..... do	0	80
Tree 150 years old..... do	2	00
Tree 200 years old..... do	4	00

The consumption of forests in railway construction is seen, therefore, to be even greater than the figures indicate, and very wasteful.

Assuming that it will usually require thirty years for trees to grow to the size requisite for furnishing ties, in order to keep up the supply for the existing roads there will be needed thirty times the area which is necessary for the supply in any particular year, or 12,672,000 acres, an area somewhat larger than that of the States of New Hampshire and Vermont.

These comparisons show in an impressive view the present demands of railroads upon the forests for their construction, but with the annual increase of the roads this demand will be increased, many of the roads also making a far greater demand upon the forests for fuel than they are for ties. The railroads of the South use wood almost wholly for this purpose. We have no statistics as yet in regard to the amount of wood thus consumed. An estimate for the single State of North Carolina puts the consumption at 250,000 cords annually. But if we take this into account and also the amount of lumber necessarily used in the construction of cars, we cannot fail to see that the railroads are making very great demands upon the forests, and that these demands are enlarging every year.

CULTIVATION OF TREES ON THE FARM.

In the preceding article is given the experience and method of the Hamilton amateur in raising young trees of the Norway spruce. There is no better tree for general ever-green work. In this chapter is given the method of raising from seed and planting out of all other trees, deciduous and conifer. After they are once forwarded to the stage reached in this article, that is, placed in nursery rows, future planting is easy. If the young trees, by the transplanting to the rows, have not yet obtained sufficient root to

please us, all we have to do is to transplant them once more, and that time they will greatly improve in number and strength of root fibres. Then, to plant them out, all that is necessary is to see that the place of planting is drained, that is, that you are not digging a hole to hold water, but that it will have some exit; then dig deep and wide enough, get the ground in good tilth, dig in sand, if you choose, to clay, or clay to sand, or manure to either, but do not place raw manure there; incorporate it well with the soil. Then set your tree at the height it was, what is called its collar, on a level with the earth, spread the roots and press and mix the soil with them, and cover all firmly, but not too hard. Stake if necessary. Mulch by all means; it will often make all the difference between success and failure. At first, if you have plants enough, shade all the land with your tree tops; then, in successive years, thin the trees well. This is in plantations; but if only in lines, all that can be done is to plant, mulch, and protect from cattle.

Growing our forest trees from seeds, if attention be paid to a few simple details, is as easy and certain as raising any other farm crop. In the first place all tree seeds can be sown when they mature. That is the time, namely, when they fall, that nature sows them. Taking first the principal nut-bearing trees, oaks, walnuts, butternuts, hickory, beechnuts, etc., some ripen earlier, but all may be gathered in October. In the second place the slippery elm, white elm, witch elm, corky elm, silver maple and soft maple, ripen their seed in June. In the third place, hard maple, Norway maple, box elder, plane tree, birch, basswood, locust, wild cherry, alder and mountain ash, ripen their seed in the fall. In the fourth place we will put the evergreens, that is to say, pines, spruces and cedars, which also ripen their seeds in October.

Concerning our first group, the nut-trees, leave the nuts in boxes, mixed with a little damp earth, until you are ready to plant them. If you cannot sow them in the fall, leave them out of doors where they will remain frozen, or leave them in a cellar so cool that they will not grow. The method of sowing these, and those of the third class, is as follows:—

Take a piece of good dry land, sandy loam, if possible, for this reason, that clay often bakes, and makes it very hard for the young plants to get through. If, however, a clay soil only is obtainable, sand, any sort, should be brought to cover the seed in the drills. The land should be slightly sloping to insure drainage; plough or dig it deeply and well, and harrow or rake the surface smooth. Make the drills twenty inches apart, six inches wide, and two inches deep, and sow the nuts and seeds three or four inches apart, remembering that a large nut will grow a tree no larger than a little seed, but that it needs deeper covering, say always twice the diameter of the seed. Press the earth firmly over the seed. A twenty-inch drill gives room for weeding and hoeing. Then we should cover all with some sort of litter such as straw, manure, leaves or stalks, which, when spring sets in and the young roots are about to come up, should be raked off the plants and left between the drills, if it be workable with the land in hoeing, if not have it removed. You must hoe and weed these seedlings during the summer as you would a crop of roots.

For future cultivation of this class, all fibrous-rooted trees may be left here two years, but the nut-trees being tap-rooted, must, if they grow rapidly, be taken up in a year, if not, leave them two, but never more; but after two years, at all events, they will all be ready for transplanting, the method of performing which is as follows:—

As early in the spring as the ground will allow for digging, have the seedlings dug up. They should be assorted in two sizes, the large and the small. With a sharp knife cut the leading or tap-roots back to within six inches of the collar. Do not touch the

tops at all, tie them up in convenient bunches for handling, dip the roots in a thin mud and heel in ground convenient to your work. The best soil to grow all kinds of trees in nursery rows is what is known as a sandy loam with a clay bottom. To prepare it thoroughly it should be summer-fallowed the season previous, but this is not necessary, though desirable, as any land in fair tilth will answer. Having it ploughed and harrowed, set the line parallel with the longest way of the lot, if most convenient to cultivate that way. The line set, level all inequalities of the soil with the spade under the line and pat the soil down firmly by striking with the back of the spade on the line. The next operation is to cut out the drill by striking with the edge of the spade parallel with the line run, as it were to split the line. The drill is now dug out a spade wide and the soil put neatly on the opposite bank from the line—the bottom of the drill being evened with the spade as the digger goes on digging out the drill. All is now ready for planting, and the planter, provided with a bundle of plants, stops and places a seedling neatly against the bank, placing the collar of the root evenly against its edge. Another person at the same time places a spadeful of soil with a quick turn of the spade snugly and securely against the roots of the plants. The plants want firmly treading and straightening, and the balance of the trench may be filled in and levelled off. A convenient distance for any kind of forest tree in a row would be one foot apart and the distance between rows four feet. This allows cultivation with cultivators and single plough by horse and man, and is in every way convenient for growing trees straight and in good shape. Out of these rows the trees may be transplanted at any time, spring or fall, to other places, or if the idea is to leave them there permanently they will succeed.

Now we will take class No. 2, consisting of elms and maples, ripening their seed in June. As soon as these seeds begin to fall, the main crop on the tree will be ripe enough. These trees bear great quantities of seed, and as they ripen early in summer, if the seeds be sown then they will grow in the same season, making a foot or more of growth that year. The same directions as previously given contain all that is necessary in sowing these.

The next directions to be given apply to the evergreen class. Hitherto young trees of all kinds of evergreens have been easily procurable in abundant quantities from neighboring woods and swamps. There are still great quantities to be easily secured; nurserymen and large planters have drawn their principal supplies from the woods, and as they have always been able to secure their stock without much trouble, very little attention has been paid to securing seed and growing it. The white pine ripens its seed in the fall; the cones may be gathered whenever convenient, late in the fall or through the winter; by exposing them in a warm, dry room the scales of the cones open and allow the seed to drop out. This should be gathered at once, as mice are very fond of resinous seed, and would destroy them as fast as they dropped out. A good plan to secure the seeds of spruce and pine easily is to cut the branches having the cones on, tie them up in neat bunches, cover all up in muslin and suspend from nails in a warm place, over a stove or other heating arrangement, have the mesh of the muslin small enough to retain the seed; after the seed is all out put it up in paper bags and keep in a dry place. The seed of the cedar should be sown when gathered in the fall, either in drills or broadcast in small beds enclosed with boards, covering lightly with soil in which a goodly quantity of sand is incorporated, and mulching over with leaves. In the seed bed they may be allowed to remain three years when they can be carefully transplanted to other places in nursery rows; select a damp, partly shaded spot for sowing the seed. A similar plan will answer for the pines and spruces. The most necessary element in the successful growing of evergreens is keeping the soil in a uniform state of moisture, alternate damping and drying of the soil being fatal to seedlings. Persons familiar with the country and tree growth will often have noticed the thrifty little pines, hemlocks and cedars, growing on the damp hillside generally facing the north. Here, self-sown, they rear their rich green foliage to the passing breezes and the blue skies above. A moment's reflection and study will convince any person of the proper and essential rules to be observed in growing young evergreens. They are, a uniform moisture of the soil, the earth to be of a rich, loamy nature, full of sand and leaf mould, plenty of air and partial shade. Any system

embodying the foregoing principles must be successful. Evergreens, when small, thrive when planted closely together. They thus afford protection to each other, from the density of the foliage preventing the wind from a too boisterous acquaintance, shading the soil, keeping it damp and cool. So it follows when planting in nursery rows, plant them any distance that the outer branches just touch each other, and the rows far enough apart to allow cultivation easily. As the trees continue growing in size, keep trimming them out either in the rows or by taking each alternate row out altogether. One rule to observe in the cultivation of evergreens is that they thrive best by themselves, not when planted indiscriminately among deciduous trees. They will grow on poorer and thinner soils than deciduous trees. It does not follow, however, that they require poor soils to grow in; like every other plant, they thrive in a corresponding ratio to the treatment they receive, and will grow better on good soils than on poor ones, etc.

There is another method of getting these young seedlings than growing them in Ontario, as all know, that is, of importing them from foreign growers. As my readers may wish to know the facilities for doing this at the price charged, I will furnish them with a copy of a letter from Mr. Miller, owner of the chief evergreen windbreak mentioned in these pages as existing in Markham, as to the firms from which he procured the seedlings, and the cost:—

“MARKHAM, August 3rd, 1887.

“DEAR SIR,—In reference to the spruce, I imported the trees from Little & Ballantyne, Carlisle, England. They were twice transplanted, and from twelve to fifteen inches in height. I think they cost there about fourteen shillings per thousand, without packing. The boxes and packing cost more than the plants. The freight from Carlisle to Liverpool generally was more than the freight from Liverpool to Toronto. I imported several times, and they cost me from \$10 to \$17 per thousand, delivered in Toronto. I had an offer from the firm of Austen & McCasten, of Glasgow, to deliver them in Toronto at twenty-eight shillings per thousand, but I never got any from them. They were willing, I may say, to send a large quantity, if ordered, at a lower rate. Trees, I may remark, should not be less than one foot in height, and should have been twice transplanted. I think that is all the information I can give, having unfortunately destroyed all my old invoices and bills which relate to this.

“Yours truly,

“JOHN MILLER.”

With reference to prices, trees can also be imported cheaply, perhaps not so low as this, from Douglas & Co., Waukegan, Ill., an excellent place to obtain evergreen trees. But as it is not well, if we can avoid it, to send money out of the country, I should advise all tree-needers, before importing, to consult with some Ontario nurseryman as to the price they can be furnished at here, and having been informed on the matter, take their own course as to purchasing at home or abroad. There are many reliable Ontario nurserymen, though indeed, in opposition to either importing or buying here, there are reasons why a farmer, if he can, had better grow his own.

A PLANTATION AT NORWOOD, COUNTY OF PETERBOROUGH.

BY T. M. GROVER.

It is gratifying to notice that throughout Ontario many farmers, since information has been published and general interest excited on the subject, are planting considerable numbers of trees. The following statement by T. M. Grover, Esq., Norwood, a gentleman who has made considerable progress in this direction with excellent results, will be

found valuable, both as giving results of experiments and showing how easily plantations may be grown, with care, even by those who have not previously given much time to such work. Mr. Grover says:—

NORWOOD, 24th September, 1887.

DEAR SIR,—In sending you a memorandum of tree planting done here, I have to acknowledge the value of your previous reports on the subject. I have been working at tree culture for about three years. The permanent plantations were laid out this spring, 1887. A little over 5,000 trees are planted, where they are to remain. About 8,000 transplanted seedlings have been put in nursery rows and nearly as many more from seed are growing, some of which have overtaken in size the last year's seedling of the same species. I am carefully collecting tree seeds from every forest I visit and find a new interest in every tree that in former years I never noticed. Tree planting has been all done in the spring. I have selected black ash, soft maple and sugar maple for moving from the forest this fall.

Probably you do not hear your letters to the papers spoken of. I hear many persons who do not own a foot of land, but who read the letters, speak of trees and the information you give them. I find your list of trees in the report for 1885 a valuable reference in all cases of doubt, and on many points I had little other instruction. Beginning, as I did, to teach myself, and I feel sure if I had told everybody who speaks of trees that they could get such a report, you would have plenty of applications for them. Everyone has an opinion on trees, and since I have learned a little about the subject, I find most farmers have entirely mistaken ideas about their growth and culture, but all willing to learn and quite surprised when I tell them the possibilities. I intend to apply myself to the practical point of the subject and keep on till I can show a visible result, as well as instruct myself in the theory and principles of forestry.

From the amount of tree seed I am collecting, etc., I will have something to show in the way of arboriculture another year and shall be glad to show it to you.

I am, sir, yours truly,

T. M. GROVER.

The forest experiments here were begun with the distinct object of forming a permanent plantation of trees in blocks at even intervals, to be cared for during the first years and protected for the sake of the timber, regarding the money value of the wood, as well the advantage of the grove in the mean time. As a protection to the farm lands the lots were selected on the west side of fields, and to keep the work in view for observation and experiment, it was not convenient to plant the whole in one block, as the west side of the property was broken by the park lots of the town.

The result, though not so conspicuous as a belt of young timber would be on the side of a large farm, is so interesting, and promises such success, that only full information on the subject of Forestry can be necessary to excite the serious interest of all occupiers of land.

It would be out of place here to mention the many cases where plantations would be of profit to owners—the lands suitable, the possible or certain value of the produce, the easy growth of trees and seeds, the various native and foreign trees and their peculiarities, the advantages to climate, soil and crops, or to recite the history of known plantations in other countries. But the management of a small plantation will be in itself a lesson on the whole subject, and there will not be wanting full information for zealous foresters; and like any other scientific subject, more study leads to greater interest.

THE TREES.

Without previous acquaintance with the trade in nursery stock, the chief difficulty was to find a dealer. Forest trees can be got easily, but no one here had ever put any in cultivated ground and no idea of the expense could be formed. Some workmen had

formerly put out maple and spruce at 25 cents each. Certain nurserymen and tree peddlers had sold ornamental trees at 50 cents to \$1.00 each, and, being generally put on lawns in the sod, few succeeded. The trees here were selected more by prejudice than by special knowledge, and without experience in importing trees there was little to guide in the time to order or the kinds or the state in which they would reach the field. But trees are of great vitality, and although they don't look or act as one expects, a little care will bring them at last into good order.

In this lot were some transplanted white ash which seemed so dry and dead that every farmer who saw them pronounced that they could not grow; were dead in fact before they left the nursery. They looked dead, but they came on slowly, and some which were cut down low while despaired of, put forth such a growth of leaves and shoots that it was evidently a mistake to cut them down. In fact a live tree may not show much sign of life till near the end of the season, but when carefully tended may do well. All large planters in the United States tell us that with care any young trees may be moved without five per cent. of loss.

The following list shows what was done with native trees:—

Native Trees.	Percentage living.	Greatest Growth.
Sugar maple	90	1 foot.
Soft maple	94	Small growth.
Basswood	90	Slight.
Black cherry	75	20 inches.
Elm	95	1 foot.
Black ash	95	Slight.
White ash	all	1 foot.
White oak .....	..	Little growth, but live well.
Black oak		
Butternut		
Mountain ash		
Bitter nut (long tap roots)	50	
Spruce	95	1 foot.
White cedar	80	9 inches.
Tamarac	85	Slight.

In this locality maples are easily got of any size and easily moved; the maple seems to resist the browsing cattle (the greatest enemy of our woods) or to start up again better than other small trees.

It has always been difficult to find small basswood, chiefly because it is first taken by the cattle, but in a bush where cattle do not enter, basswood growing in single trees of all sizes will be found as well as a good variety of other native trees. In about half an acre of unbroken land, in a corner of a field, 150 good basswoods were found from one foot to six feet, and safely moved. Spruce, tamarac and cedar may be successfully taken from a wet marsh, where small trees only are left and the surface grown to a sod and in the open sun. The roots do not go below the sod and moss, and generally all will come away in a mass, and the trees are little checked by moving to dry ground; the roots of evergreens, as well as other trees on high ground, extend to a considerable depth, and are much more trouble to move successfully.

A MAPLE FOREST.

On an acre of good land it will be easy to raise 680 maple trees. Such a plot has been laid out here; 300 or 400 of the trees, about eight feet high, were planted early in May, eight feet apart. Nearly all were cultivated with corn and doing well. The ground at one end was sown with oats, and the trees not cultivated, and these have not done nearly so well, one-third being already dead.

The grove will be extended to one acre this fall, with trees of two or three feet in height, and it is generally expected these will overtake the larger trees. It is in a con-

spicuous place near the town, and the expense of an experiment like this is little, and not beyond the means of every farmer. Any one can see the good likely to come of it. The timber would be of good size for fire-wood before the remaining bush on ordinary farms is used up, and here where the value of maple sugar is not forgotten, 600 trees on an acre would be worth saving for sugar-making alone.

A MIXED LOT.

A lot of two acres has been planted with a variety of trees (native and imported). At intervals of eight feet were put white ash, black cherry, walnut, catalpa, sugar maple, basswood and black ash of three to five feet in height; then the lot was filled to spaces of four feet with ash-leaved maple. The land was good, well cultivated, and all have made good growth, some at one end stood in a low moist spot, and there the trees have grown very much more rapidly. The west side of the lot is filled close with spruce and cedar, and being west of the buildings is intended as a shelter belt as well as forest.

A further lot of four acres is laid out to be planted with white ash, walnut and locust, in separate sections. The trees for this are still in nursery rows.

IMPORTED TREES.

The list following gives the experience of the last three years :—

	Percentage living.	Best growth.
Black walnut	98	2 feet on a three-year-old.
White ash .....	..	2 feet 3 inches.
American elm	65	3 feet.
Ash-leaf maple	98	3 feet 6 inches.
Catalpa	97	16 inches.
Sycamore	60	14 inches.
Silver maple	98	2 feet.
Kentucky coffee tree	90	1 foot.
Norway spruce	90	8 inches.
Larch .....	..	All failed at the start.
Russian mulberry .....	..	Not hardy.

The last Report of the Agricultural College tells us, and the experience here is that it is not safe to cultivate trees after 15th July. The frost of 8th September has killed the upper or last grown leaves of walnut, catalpa, mulberry and chestnut—all due to a late hoeing, which induces a new growth not hardening enough to stand the winter.

Most varieties of seedling trees can be bought at the nursery cheaper than searched for in the forest, unless very convenient. Another advantage is in getting them all of one size and style, and the risk in moving is about equal.

There is the question of hardiness in our climate to be considered in all importations, and without longer experience it is hardly safe to try new varieties to a great extent. The walnut has been considered doubtful by many in eastern Ontario, so that the success of the large plantation from twenty-five bushels of nuts in Quebec, is of importance. Tree pedlars have sold plenty of mulberry and chestnut, which they must have known were not hardy here. The catalpa speciosa planted here this year are experimental, for although raised at Campbellford, fifteen miles from this, their hardiness is not assured. They have, to some extent, succeeded in Quebec, and would seem safe here,—a vigorous, showy and profitable tree worth trying. The most interesting and satisfactory tree is the black walnut, and all appearances of it agrees with the success in the Western States. It has a large, soft root and is easily grown in any ground; no frost appears to hurt it except in very wet ground.

The white ash seedling is very easily planted, and of sure and rapid growth, perfectly hardy and of known value and success in plantations: the walnut and ash will always be the most valuable trees in this climate.

A large lot of the imported trees were put in nursery rows, about two feet apart and thoroughly cultivated. It is easier and better than to trust a small seedling in its place in a large plantation, and another transplanting will do no harm, and sizes then can be well assorted. Here seedlings are being provided for about twelve acres of timber, to be placed as soon as the trees appear strong enough.

TREE SEEDS.

Most of the nurseries in Canada have given up planting tree seed, and buy seedlings in the United States, Britain or France, where advantages of climate enable nurserymen to sell at very low prices, by the thousand or million.

There is no trouble, however, with any tree seed; they are as easily raised as any vegetable; but it is not advisable for any one in this country to raise trees from seed, except as an experiment.

This list is the success here:

Seeds.	Best growth.	When planted.
Black walnut.....	14 inches	Nov. 1886.
Sweet chestnut.....	9 "	
Catalpa.....	18 "	May 5, 1887.
White ash.....	16 "	"
Yellow locust.....	6 feet 6 inches	"
Mulberry.....	12 inches	"
Soft maple.....	7 "	June 20, 1887.

Evergreens.

Pine, white.....	} Grow well, but this very dry season came up very irregularly and are practically a failure.
" Scotch.....	
" sugar.....	
" Anstrian.....	
Spruce, Norway.....	
Larch.....	

LAND FOR SEED.

The earth for seed-beds should be good garden soil mixed with sand to prevent the surface hardening when watered. The seed-beds here would have been much more satisfactory, but unfortunately forest mould was used, proving very bad for drying-out, and delaying the germination of all the seeds.

Conifers in this climate require shade for the first two years; best given by a lattice of lath, close enough and boxed about to keep off birds and mice, which are very fond of the seedling evergreen. The little seedling is also easily killed by excess of dampness or drouth, and in this very dry year, with not exactly proper care, the evergreen seed-bed has not been successful; and as other climates are so much more suitable it is really better to import seedling evergreens in all cases.

FORESTS AND PLANTATIONS.

Various writers on Forestry advise the planting of forests on soils unfit for agriculture, and generally some such spot can be found on every farm—a bad hill or rough stoney spot—but to any land a ten acre block of forest on the west of the homestead would be of value as a shelter, and the better the land the better the timber. In ordinary bush, the number of good trees per acre will not average more than fifty, and many of these will not be really alive and growing more valuable. When it appears that 680 good trees can be raised on an acre, it will almost seem as if it would pay to gradually replace natural bush by a proper plantation. Even for the use of the farm, and there are so many farms that for many reasons cannot be cropped to advantage, it would be a relief to the owners if the land were employed in growing a crop requiring no further culture, and steadily improving in value.

In the vicinity of Lake Erie where walnut, chestnut, hickory, and white-wood, are in their native home and of such rapid growth, it would not be out of the way to estimate the actual cash returns of a forest as equal to any other crop. If yellow locust—equal to cedar for durability and to maple for fuel—will grow in ten years from seed to make a railway tie (and it promises that growth in this ground), if ash and hickory will yield a full crop every year after the fourth, and if all these (in coppice) will sprout from the stump and yield in future years the same timber in half the time, it may easily appear that timber will be a good crop on the best land. There are many good farms in every county in Ontario in the possession of old people, of females, of trustees and of tenants, and of which proper profitable cultivation is not possible at all times, but which would steadily increase in value if part was planted to timber, and at a future day would be of greater value than all the income that could be derived from it in the meantime.

FORESTRY

is a science ; we have not come to that yet. The relation of each tree to the whole forest, the shade-enduring and the light-needing, the rapid-maturing trees, the nurse trees, the short-lived trees, the study of a century of growth, survival, influence of each variety on the other, and on the soil—in fact the whole subject of National Forestry—will soon call for ardent students, and every step on the way will, we hope, be of profit and encouragement to the individual and to the country.

CHAPTER VI.

WORK OF THE YEAR, AND SUGGESTIONS.

Since the publication of the last report, as will be seen by previous statements of results, examinations have been made as to the amount of firewood remaining in settled Ontario ; and into the results of the fire-ranging system lately adopted, and the method of settlement location near pine lands. A close forestry examination has been made of two townships—one north and one south—the first being elevated land, the other much lower, and one of them facing the Georgian Bay, the other Lake Ontario. Opinions of most of the farmers in these have been taken on their observations of the effects of clearing and shelter, and the apparent effects noted, as evidenced by the crops. The press has been largely used to lay the information gained previously before the country, some five or six hundred letters and articles having been printed in the various journals, while a large edition of the previous report has been carefully distributed among those likely to profit by it.

I would recommend that the plan of a forest reservation in the Nipissing territory, suggested in previous reports, be proceeded with, and that there the experiment be tried as to how far, and at what expense, it is practicable to destroy the pine refuse caused by lumbering operations. If the result proved satisfactory, regulations concerning the matter might be introduced in the sale and management of timber limits.

It would seem advisable, in view of the fact that many lots have been taken up and abandoned, being found unsuitable, and that the fires in clearing such have caused much damage, that no lot should in future be settled on until an official has reported that it is fit for agricultural purposes, and not dangerously near to pine woods.

It is common in Europe to distribute free of cost large quantities of young trees, generally from Government nurseries. The adoption of this practice, either by governments or counties, would be valuable here, if the expense be not thought too great. Greater attention to Forestry is undoubtedly now being given in Ontario; but this would add strength to the movement. It is suggested as the most practicable way of encouraging plantations. The Tree Planting Act aids the planting of trees in lines, thirty feet apart; but these, though valuable for shade and shelter, cannot give good, clear timber, which is only produced in plantations or forests, while to pay a bonus on the large number of trees in a plantation would necessitate too great an expense.

It would be of great advantage, if found practicable, in cases where elevated lands, in regions about to be settled, occur, that where these comprise some thousands of acres, they should be kept wooded, either by withholding them from settlement, or agreement with the settlers that the mountain portion should be kept in forest.

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*Ontario Forestry Bureau
Annual Report
512*

FORESTRY REPORT.

1887-8.

COMPILED AT THE INSTANCE OF THE GOVERNMENT OF ONTARIO.

BY

R. W. PHIPPS,
TORONTO.



Toronto:

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1888.

To the HON. CHARLES DRURY,

Minister of Agriculture, Ontario :

SIR,—I have the honour to forward the Forestry Report for 1887-8, being the fifth issued.

It has been the effort in this series of forestry reports, in each successive issue, to avoid the ground travelled over in former ones, and to present, every year, fresh information on the subject. The present Report will be found to contain :—

Notes on English and Scotch forestry, compiled during a visit to Britain last summer.

Synopsis of evidence taken before the British House of Commons Committee on Forestry, those points interesting to Canadians being selected.

Articles giving the latest information from experimental stations as to influence of forest on rainfall ; on the best methods of preserving timber ; and on the proper way of pruning trees, the last illustrated by numerous wood-cuts.

Lists of trees suitable for planting for timber and shelter, and advice of leading planters on the subject, with much other forestry information.

Respectfully,

R. W. PHIPPS.

INTRODUCTION.

The following pages are, for a considerable extent, devoted to a description of the various British forests. It has been a common remark with those Canadians who have of late years travelled through Britain, "that they seem to have more woods than we do in Canada." This view is, if we except the fact that on the north our cleared country is bordered by a forested region, quite correct. In their farming, or "cleared country" as an American would call it, far more trees are left, far more encouraged to grow, than with us. When we consider, in connection with this, that the British crops average much more than our own, it is plain that their farmers lose nothing by the practice. Could we but institute such a practice here, we might hope for such crops as theirs, for it is our overclearing which is drying up the land. Not that we can change the sum of moisture in the clouds, or that which permeates the earth, but we can and do, by overclearing, check very prejudicially the beneficial circulation of the moisture from the clouds to the crust of the earth, from the earth to the clouds again.

Individual tree planting, individual forest preservation, are excellent, but more general measures would be far better. In this we must trust to the deliberations of our farmers' institutes, and the action of our municipal and governmental bodies.

The report will be found to contain other and extended writings on matters of forestry or kindred thereto, to which the reader's attention is directed. Among these the various plans suggested and methods used for the preservation of wood are well worthy of attention. Wooden structures, especially those which are near the earth, such as plankings, could well be instanced which have within twenty years been renewed three times, yet which, there is every reason to believe, would have remained sound from the first construction had some of the means described been used for the preservation of the timber.

There will be found other articles here interesting to the grower, the buyer or the user of wood. There are the directions and pictures concerning pruning, one point alone in which uninformed industry yearly inflicts great damage on itself. There are the quotations from the British Parliamentary Committee reports on forestry, which have been selected in those points interesting to the Canadian reader. There are also the valuable articles on rainfall and forest management furnished by the forestry bureau at Washington.

Finally, whatever be written here about trees, let us remember that its value depends upon its effect. He is the real forester, the real benefactor of his country, who preserves a portion of woodland in forest completeness—who plants in the season some thousands of trees, and, when planted, cares for them. To press this course of action on those in whose power it lies, is the object of the work.

FORESTRY REPORT, 1887-88.

FORESTRY TOUR THROUGH BRITAIN.

It is June, and the great steamer has left the shadow of the Quebec cliffs and is making her way through the Gulf to the Atlantic. Leaving Toronto a week before, where the thermometer has stood for three days close to 90 in the shade, the change to this atmosphere is startling, where the glass is at 40 and ice is packed in shallow floating islands from shore to shore, lifting and falling on the wave-crests, and rolling tumultuously back on either side as the prow grinds rapidly through. Now and then, in the distance, a vast iceberg towering pure-white on the horizon is seen, neared and passed, all the passengers carefully viewing it, borrowing each other's glasses to see it, saying it is very beautiful, and that they see another farther off. Except these, the ice-clad waves and the great mountains on each shore clothed with scanty forests, there is nothing to see till we reach the Atlantic, and the last light-house has faded from view.

There is little then. The ice has disappeared, the broad ocean rolls on all sides, but it is the most uninteresting of oceans. A voyage to Europe may be healthy, but it is one of the dullest ways to health. At first most of the passengers are sea-sick, and when, in a day or two, they are well again, the same wave at the same angle, tipped with the same foam, seems perpetually to recur, and there is nothing else to see. There are few birds, scarce even a whale, scarce a ship on the track to vary the monotony. There is tolerable security from collision, indeed, for we see nothing with which by chance we might collide; and this belt of ocean has not the swarming life either of the torrid or arctic seas. You keep on deck, partly that it is ocean passage religion to breathe as much sea air as possible, partly that there is an abominable smell or steam of cooking and other odours indescribable, pervading all below; and most of the time a procession of passengers, two by two, in long succession, travels down the deck on one side and up it on the other, varying this by sitting in long rows of easy chairs against the upper cabin walls, covered with rugs and great coats till they present an appearance similar to a clothing store when the proprietor has heaped all his floor with confused piles to satisfy a troublesome customer. The great saloon is well enough to sit in, but there is no quiet; the jarring concussion of the screw each instant vibrates all around; and this is better borne where the sea is visible. The great relief is the hour for meals, when there is far too great a multiplicity of dishes, and all tasting very much like each other, as if all were cooked in the same oven and had absorbed each other's flavour. One point should be here noticed, the tea was most wretched, tasting so strongly of something resembling smoke, as to disgust the

drinker. Here, especially when ill, the passenger expects relief from his or her usual beverage, a cup of good tea, and to hear that there is nothing but this vile decoction obtainable on board, is productive of misery which on shore may be laughed at, but here is very real and very injurious. Coming and going it was equally bad ; and I hear it is so on many ships, and is kept so in spite of complaints. On the other hand, plenty of good food is provided.

But the eight or nine days soon pass and we reach the English shore, or rather the Irish, along which we sail for some time, and pass a few hours in one of their harbours. Now, of this coast, something may be said in a forestry point of view. It is rugged and mountainous ; there is, along all the many miles we pass, scarce a tree in sight, and a distant range of mountains slopes to a nearer, the nearer range to the shore. These are partly cultivated ; that is, as we can well observe from the sea, every sheltered valley—every depression is fenced and cultivated, while all which is open and wind-swept, say three-fourths or more of the whole, lies idle and barren, or at most yielding a pasture apparently extremely scant. Now, the lesson we may gain from this. These mountains and valleys alike were once covered with wood—the mighty oaks they bore furnished many a historic fire to the heroes of Ossian's day, and the songs of that period commemorate a wastefulness of timber which—but that I have seen greater waste in Canada—I could scarcely have believed. These barren mountain ranges could only at immense expense be re-forested now ; the earth is wasted to such an extent away. Still, a tree will grow in a rocky crevice where no one can imagine whence the nourishment arrives ; and it could be done. But how easily could they have been kept in forest, and then all the slopes below them would have been better sheltered and far more fertile than the few cultivated valleys we now behold. We have in Canada many ranges of hill and mountain now wooded which, if not better cared for than the Anglo-Saxon has used most American forests, are destined, in our hotter and drier country, to a final barrenness worse than that of these Irish hills. We should now, while it is yet time, take care to preserve from the axe, from fire, and worst of all, from cattle, such reservations of these as will keep fertile the slopes below and continue the streams which rise in their recesses, the future existence of which depends on the maintenance of forests on the elevated lands.

Now we reach the Mersey, and soon Liverpool, with its six miles of docks ; docks, by the way which, with their high walls and numerous buildings, so enclose the shipping that from the river but little of it is seen, except when, now and then, the constant ferry-boats pass over to the Birkenhead shore, or some great steamer puffs hugely down the river bound, it may be, to any part of the world. Here we seem to enter that great, brown fog which the old Romans believed continually enclosed Britain, and out of which, during the two or three months I stay there, we scarcely ever get—I think we had in that time three, if not four—sunny days, though it must be allowed that that luminary did appear on others, but invariably retreated hurriedly and in apparent disorder, judging by his yellow face. One of these sunny days, however, being the next, I take a long walk through the farm country which stretches past Birkenhead, a great range of alternate dale and upland, of which the Welsh mountains, blue in the far distance, close the prospect ; and here, it being the early hay harvest, I observe a mode of building a haystack

new to me. Barns, as we know them, are scarce; stacks are much used, and these they are building, (that is, nine or ten men and some teams), as big as a church, and procuring the height by a long elevating belt similar to that used on a threshing machine, which, reaching about forty feet, and turned by a horse-power below, carries the hay far beyond the height of ancient stacks, when the highest point of vantage to pitch from was the top of the load. It was certainly very effective.

What is especially noticeable here is the number of trees which are left along the hedges, and the hedges themselves. Between these, and the small plantations of trees, oak, chestnut, sycamore, and others, which are seen every here and there, the whole farming country seems much better sheltered against winds, and much better forested, in the sense in which trees are believed beneficially to affect the climate, than the generality of the farming districts of Ontario. In Ontario we can observe very large spaces—broad stretches of country quite destitute of a tree, a thing even more general a few years ago than now, when rows of young maples are beginning to be planted in many localities. But still, compared to Britain, we are in the settled parts of Ontario very scant of forest growth, or of the tree and plantation growth which in some measure compensates for it. Throughout the history of the world it is found that those nations decreased in vigour, and those countries in production, where the forests were most carelessly destroyed, and this fact tells more rapidly in America, owing to our drier climate, than in Europe. In the United States, in places where the partially forested land produced good crops, I have observed it, over and over, when fully cleared produce not nearly so good. In Ontario I have known townships where one-half cleared send to market twice the wheat they do now they are three-fourths or nearly all cleared; and I have no doubt that the continual good crops obtained in England,—a crop both of grass and cereals far larger to the acre than that of our own country—is owing chiefly to the fact that the land is so well sheltered by trees.

It is here that the benefit of landlordism occurs. The farmer would often cut down the bordering trees, thinking, as is too often thought in Ontario, that he would grow the grain and his neighbour provide the shelter; but his landlord restrains him, not choosing to have the appearance of his whole estate destroyed that the tenant may draw some shillings more for wheat, himself losing also some growing trees which would probably sooner or later make valuable timber. In Ontario the same feeling sometimes impels the farmer to cut down far more of the trees on his farm than is correct—for each farm, unless there is a large forest reserve near by, should be at least one-fourth in forest—thinking that his neighbours will keep up the due proportion of wood in the country. He cares little, perhaps, for the beauty of his farm; he may intend to sell it, and he is restrained by no landlord. He will hardly be restrained by his county council,—these bodies have not yet, generally, arrived at a true knowledge of such matters. It is therefore, in America, to the higher bodies,—the governments of provinces and of federated unions—that we must look to perform, as far as they may, those acts of beneficial preservation which the individual is often too apt to omit. We are doing something in Ontario—not so much as I would wish; but still we are in advance of our neighbours. So far as the influence of future profitable sales deters overclearing of farms, circumstances are working

in our favour. Partly owing to the evident growing scarcity of timber, and its necessary higher cost at no distant future, buyers of late, in several cases to my knowledge, have refused to make any offer whatever where there was no good bush lot included in the acres under consideration ; and the feeling is rapidly spreading. I know some farmers, even now, who would as soon let their cattle into their wheat as into their woods, if circumstances rendered the young trees likely to suffer.

This, too, all runs in a circle. Cattle will not injure woods if they have good pasture ; but the very best means of getting and keeping good pasture and good meadow is to keep plenty of woods near. I do not mean some acres of dried out trash of old trees done to death by trying to make the bush lot do the duty of straw-stack, hay-loft, oat-bin, and pasture field all in one ; but a beautiful forest in its natural state—plenty of young undergrowth, plenty of fine young trees, plenty of old ones ready for the axe, no beaten-down and hard-tramped earth scantily covered with rough grass ; but the rich carpet of thick leaves Nature spreads over her forest parlours. Such a wood, if wisely left on the highest part of your farm, will give you such grass as will, if you are wise, persuade you to feed your cattle from the field and leave the bush to the squirrels. I wish some of you could see the grass fields here—two tons, and sometimes much more, to the acre, well sheltered by hedges and trees. The very same thing, though not to so great an extent, I have known occur in Ontario, and year after year. The circle is, as the French proverb says :—

“The green tree makes the green field,
The green field makes the fat cattle,
The fat cattle make the rich harvests.”

The country here, owing partly to the beneficial influence of the Gulf Stream, partly, and very much, to its frequent shelter, does not dry up as does Canada. Here is a country lane—with us it might indeed be green with short grass—but here is more ; its hedges bear a thousand flowers ; the very pathway is rich with bud and blossom ; the ditches rank with heavy grass. There is, too, generally, no lack of solid walking ground—a firm, beaten track, hard sometimes with iron slag broken small, sometimes with broad, flat stones, sometimes small broken stone, but generally smooth and very hard—is found almost everywhere. In the cities and towns the interminable length of broad stone pavement is very disagreeable to a person accustomed to our plank walks. The stone tires you, in hot days, they say, (there were none, or few, in my British experience), burns you, and at all events, at night, after walking through the streets most of the day, there is a beaten and jarred feeling never experienced after any amount of Toronto walking.

There is no pavement like our plank walks. In summer they are cool and springy to the foot of the pedestrian ; in the winter there is nothing so good in either snowy or frosty weather. The snow is more congenial to wood than to either stone or any of its bepudded imitations. Wet snow freezes quickly on cold stone ; and a layer of ice or slippery surface forms far more readily on it than on wood. In frosty weather I always avoid the streets with stone pavements, and I have no doubt the wood-paved streets secure a good many customers for their shops from this cause. Now, we have, in Canada, a superabundance of the very wood fit for this—not the clear or even second quality pine, but that higher up the tree, dotted with many a knot. This is a portion which, especially

in getting out square timber, is more often wasted than other parts of the tree. With fair care of our pine forests there will always be a superabundance of timber fit for first-class sidewalks; and here is another most important point to be considered. Our sidewalks, and indeed vast quantities of other pine not far from the earth when in use, are allowed to decay far faster than is necessary. In another page will be found important advice as to methods of preserving such timber, and also details of an experiment tried by myself on plank walks during the last year. It is in the woods where such timber as is fit for this and kindred purposes is most readily procurable, that is, the pine woods whence the clearest and best timber has been taken out, that fire is apt to rage, following the chips and tree tops left by the lumberman. Here is the value of the fire ranging corps which the Ontario Government, conjointly with such lumbermen as request it, have maintained for the last few years, the expenditure on which, I have no doubt, will be—(in fact has been already) many times returned to the country in timber saved. For this saving, it should be remembered, re-acts to advantage in a double saving. It is not only the trees destroyed by fire the Province loses, but those trees, often young and fine ones, which the lumbermen cuts lest they should be destroyed by fire—trees which, were he assured of their safety, are certain at a not distant period to yield far more than their present value.

In Liverpool is a practice which obtains in many English cities, and might well be adopted in Canada. Squares are left and planted with trees and shrubs, and as a result, after passing long lines of stone or brick houses, the eye is often refreshed by a pleasant grove—an oasis among the wilderness of masonry and dusty roadways—a mass of dark foliage sometimes only two or three acres, sometimes many more in extent, subdivided by shady walks and interspersed by fountains and statues. Generally these are surrounded by high wire fences, with wickets every here and there. The public, however, cannot enter in most cases. The grounds belong to the surrounding houses—the square, in fact—and each resident has a key. But none the less, their wooded coolness is a great benefit to the passer-by, and their presence, for there are many of them, undoubtedly conducive to the general health of the city. Builders of houses in Toronto might find it to their advantage when laying out new suburban streets, to adopt the square plan. To any one able to afford the expense, a residence opposite such a little forest, in which he had somewhat of a proprietorship and a guiding vote in its management, should be worth half as much again as a house looking only to another house opposite, where, instead of a waving expanse of leaf-bearing tree tops, overshadowing pleasant walks below, he sees nothing but his neighbour's shutters, shutters he has seen so often that he knows every slat by heart. It is pleasant, no doubt, to be able to pass in a drive of two or three miles to some large public park; but more so to enjoy the privilege, at your own door, of resting in almost perfect solitude under some trees partially at least your own, and where there is no fear of intrusion by noisy parties of pleasure-seekers, or picnickers some hundreds strong. Your own grounds, if tolerably large, are of course better than a public park; but to those who have not such grounds, the little park under your windows, to which only a few families have entrance, is by far the next best expedient for carrying one's self away a little from the squares and right angles of city rooms to the ever graceful curves

and ever changing beauties of even the limited number of trees, shrubs and flowers such little parks as these can contain.

But we must leave Liverpool for London, and so enter next morning one of the "compartments" (strange to eyes used to our large and roomy cars), which receive the passengers on an English line. Our British friends discovered steam and first applied it to railroad work, but certainly they exercised their powers of invention little in forming their passenger cars, or "carriages," as they are called, and which, indeed, they resemble. At first, when a gentleman wished to travel by rail, he sent his travelling carriage, which was strapped on a flat car, and in this odd chariot he and his family rode to London, or wherever his affairs might call him. The carriage of the day was the thing to travel in, and it is odd they did not take it on ship-board. So the railway men built their cars as near like such a thing as they could, and if one had a string of the old-fashioned coaches of Sam Weller's day, each would resemble in all important points the British "compartment," which is not a compartment, but an entire vehicle, with three windows on each side, one of them being in a door in the centre, two seats right across the carriage, one looking backward, one forward, and the curves of the whole affair as near like that of the old coach, except the outside seats and the luggage receptacles, as they could build them. Exclusiveness is sought, and obtained partially, but at the expense of comfort, as may be supposed. For instance, in one carriage entered a fat governess and three fatter boy pupils of seven to ten years. This was all very well, but she produced a large basket and distributed an amount of bread and jam which they in turn divided between themselves, their cushions and mine. Now, in our Canadian cars many more would have been in the same car with us, but only one in the same seat, and none in the seat—or rather there would have been no seat—opposite. However, some things are to be said in favour of these lines—their rapidity, their smoothness of motion, and the convenience of getting your baggage attended to and yourself directed on your course by one of the numerous railway men who watch, expectant of a fee, the arrival of each train. These fees, indeed, need not be large unless you choose—three pence seems as good as sixpence; but they are perpetual, and remind one of the experience of the forgotten Artemas; all England welcomed him with a stretched-out hand, and wanted him to put a shilling in it.

The English summer landscape is superior in colour, in changing tints, in rapid transition from mountainous to level scenery; but above all, in its frequent succession, as before observed, of hedge, tree, and plantation, to the Canadian. Nor are forests of very considerable size—twenty miles and much more from side to side—as we shall see before we close, wanting. But at present let us see what, in a forestry aspect, is to be noticed between Liverpool and London.

Chiefly, that one considerable district, broken into steep ranges of hills, having no hedges, stone fences being used here, and few old trees, showing that for many years it has been to a great extent treeless, evinces everywhere that much fertile soil, for want of tree protection, has been carried away by the rain. For the action of the climate on a cultivated country where trees are scarce is first, that the drying winds bring the fields to a powdery consistency, and then the rain, unrestrained by forests to hold it back, rushes over the ground in sheets, carrying the *humus* and valuable fertilizing constituents

of the land to the valleys, to the rivers, and to the sea. The question has been asked, Why the prairies do not thus suffer? In the first place, their level character prevents so much washing of the soil as in other more hilly lands; in the next place, in their wild state the dense overgrowth of prairie grass, rich with tangled vines, answers the purpose of a forest in preventing the soil being carried off by the rain. But when once cultivated they rapidly begin to lose their best soil in this manner. In Captain Eads' calculations concerning the Mississippi mud, he always stated that a great portion was the washings of the prairie states. "The United States," he would say, "are tearing the heart out of their land with their gang-ploughs and throwing it into this river." It is evident, from the poor appearance of the land, and the few farm houses about, that this portion of Britain has been so treated. This, however, is but a small part of the wayside scenery. Many fine fields—many thousand fine trees are passed. Above all, I notice many plantations of young trees, say five years planted, or ten. For these, side hills, or ground less valuable for agriculture than other portions, has evidently been chosen. Ground per acre is very valuable here, yet they devote much of it to this purpose, wisely believing it aids the rest in growth. We have many rows of trees in Ontario, but I should like to see more plantations, say a hundred or more yards wide, and of good length, of which I see many here. Surely, if these find it pay to use their high priced ground for this purpose, we should also, who have much cheaper land, obtain equally valuable results.

We pass, or stay a moment near, manufacturing towns and cities. Here, from what is to be observed from the car windows, which overlook some of them from elevated tracks, is not an enlivening prospect, nor one which gives a pleasing idea of the life of the workman here. Miles on miles of closely packed brick cottages—or rather cottage roofs—are visible—the latter of red tiles—the chimneys rising like close set posts as far as eye can reach. Each house fronts on a narrow street—each has sometimes a little garden—often no garden—behind; but whatever one has, a hundred have alongside, for in row after row, line after line, each house imitates precisely. It is better, probably, than the American tenement system; but still life here, from the workshop home, and when home confined by brick walls, canopied with such a smoky atmosphere as here renders itself darkly visible, has certainly its gloomy side. The tree-planted squares of Liverpool and London are wanting here, so far as is to be observed from the car; yet, it is to be thought we could see them from here if they existed near us. Can it be that commercial life is more prone to arboriculture than manufacturing? We are nearing the great metropolis, and the principal thought is, just now, what a number of tunnels we are going through! Half the road is surely underground. But we are now in the suburbs; the view is now of houses on houses, churches, spires, factories, palaces, structures of all sorts extending into the farthest distance—we pass under more tunnels—we rise on viaducts over streets, houses and all—we descend again, we stop—an immense station, full of crowds of busy people, extends around us, and the guard looks in at the window, and says, "London, sir. Can I see after your luggage?"

To describe London is beyond the powers of any one not an old resident, and one who has taken care to see it, for there are plenty of residents who do not go once a year beyond their own quarter; and I was particularly struck with the fact that the policemen generally could tell you nothing of the city outside their own beat. Besides, my business

is of the woods and fields, out of the towns, so I pass the stores of the city by, look merely at the outside of the old, grey, time-washed, many-angled Tower, away down by the river edge, great buildings new and old, rising above it, and shutting it altogether out of view, (they are building now up to the very moat edge of other days) and think how poor diminutive, and inferior even an old and massive building appears when the wooded grounds which were its natural appendage are covered with the habitations of daily life and the great warehouses of trade. What would Britain have lost had all the fine churches, towers, ancient and modern buildings in London, each once possessing its own small field and miniature forest around, been allowed to retain them? Nothing whatever; London would merely have extended itself a little more towards the outskirts, as she does every day. London would have gained somewhat in health, very greatly in beauty. She is now a city of palaces which you cannot see, always excepting a few of those mighty residences of the aristocracy of a former day, which, deprived indeed of their parks, yet themselves, in vast space of inner court-yard and outer buildings, covering acres of ground, cannot be hidden, though their chief grandeur is gone. The circle is nothing without the relieving square, the flower, without the background of the leaves, the mountain without the level earth and sea, the building without the open space, the growing trees around. But individuals will not do this—or few of them will. They think of gain. Philanthropists who wished to benefit humanity; great nobles who thought their entailed mansions, their surrounding parks, might keep from oblivion their perishing names; monarchs—not the most popular ones—these gave the parks—these preserved the trees. The First William, the First Charles, the Fourth George—all over Britain stand in perpetual beauty the results of their work. Few names, in their day, have met with more abuse. In America our hope must be in the governments which hold the lands, and in the members who should advise them. Our cities, too, should refrain from disposing, for the purposes of gain, of every acre round a church, every tree round a college. Individual churches, individual educational institutions—may reap a pecuniary gain. But the moral injury to the community is greater than the benefit a hundredfold. It is not that Dives pampers himself; it is that a thousand others like him spring up around. On the other hand, one individual like Mr. Howard, the giver of High Park, improves the nature of the whole community by showing them a better way. How much greater his gain than that of one who should have sold the land for villas, or made a second Parkdale, and added to his bank account by so much. I only wish his gift had fallen into the hands of managers of other minds. What a beautiful park that would have remained, had it only been allowed to remain. I have known the place all my life. I have seen it once since the city hall “improvers” were allowed to burn, hack and hew there. I never wish to see it again.

I see Westminster Cathedral, but do not enter, wishing to get to the forests, though I should have liked to have seen Evelyn's tomb, if they have admitted one who preserved to the company of so many who destroyed. I go to the Parliament House, and see a member who, I am informed, interests himself in forestry, and who is very civil, and promises to look for certain printed reports which would have been very useful to me, yet did not, however, arrive in time. But luckily I find those who can help and will.

A letter to Sir John Lubbock procures me an introduction to Colonel Pearson, one of the best practical authorities on forestry in Britain—or perhaps, since his experience is both European and Asiatic—in the world ; and I find him at his home, just within the Welsh border, a beautiful rural residence, on broad and level land, just beyond, however, some of those tremendous ranges of precipices which show the nature of the Welsh fastnesses of former days, and what were the natural aids which enabled the Cymri for so many centuries to hold their own against the Saxon bow and Norman spear. Where not too precipitous, their Welsh descendants now clothe these hill sides with trees, and reap a goodly profit sometimes therefrom, as we shall afterwards observe.

The colonel, an old campaigner, who I believe, retired from the field to the forest, and now from the forest to the bank—not one of those whereon the wild thyme grows, but of a monetary nature, in a village near, where he is now connected with its management, first meets me in the street at the inn door, at night, in a pouring rain, and engages to drive me to his country residence next morning. What a village this is, still on a main road ; but once for mail coaches, now superseded by the rail, which indeed brings many more travellers than before, to pass, not to stop at its hospitable taverns, which remain, their great signs swinging over the doors as of yore, their great but unused stables in the rear, once vocal with the clatter of coaches and post-boys, guests and landlords, waiters and coachmen. “ Ah ” said an old hostler, rubbing down one horse in a stable once fit for forty, “ I ha’ seed a dozen o’ they coaches out theer in th’ road, all a hurrying in or out.” The place has other resources, and no doubt thrives. But not in the old way.

Colonel Pearson is evidently the very man to give me the clue to the information I seek ; and, (not always a concomitant of knowledge) is most hospitably willing to render me every aid. He draws me up a complete route to the various forests I should visit in England, with each railway and point of departure and arrival noted, and gives me letters to the gentlemen in charge of each, with all of whom he is personally acquainted, adding also one to the well-known East Indian forester, Dr. Cleghorn, of St. Andrews, Scotland, who will, he informs me, be able to direct me to the Scottish forests. Colonel Pearson drew attention, as we passed on our way to the station, to a hill-side lately covered with larch trees, of no great size, but which, showing signs not of maturity but of such commencement of decay as proved the soil could no longer well support them, had been cut down and sold. The hill-side forest brought just two thousand pounds, or ten thousand dollars. It will again be planted, and, as the ground is too precipitous for anything but pasture, and even left in that the rain would wash away all the soil, nothing else would pay nearly as well. It has been planted twenty-five years ; we could not well judge the number of acres, but they did not seem many. I know many hill-sides in Ontario which, planted in larch, or in white ash or cherry, intermingled say with maple to be thinned out when necessary, should in twenty-five years sell for much money. The larch is a new wood, comparatively, in Canada, but in the States it seems to grow well on fair soil wherever well drained (for although it is near in kind to our Canadian larch, the tamarack, it will not grow on wet land. Yet those who have cut our tamarack in the swamps will remember that it grows best on a great hummock rising above the swamp level.) Larch

should, therefore, grow well in Ontario on fairly good hillsides. It grows well on poor ones here. As for the white ash, cherry and maple, as also, indeed, most of our trees, I have found them grow well in second growth, closely standing, on hillsides in Ontario.

There are some fine larches here; the colonel shows me one in his grounds seventeen feet round at five feet high and a tall straight tree. In fact the larch seems to give the straightest stick here. All planting here, however, in plantations, seems done with a view to getting tall straight trees. Four feet, or five each way, seems the most they are set apart. Here I would observe a difference between American and British practice. In the Highlands—the home of the larch—it was said to me of it, and in fact of all, “Plant close, but do not neglect thinning when needed.” The great American planter, Douglas, of Waukegan, on the other hand, practices letting plantations thin themselves by the survival of the fittest. So they do in the great pine plantations on the Massachusetts coast. Mr. Fay, on his grounds there, showed me where he had spent a considerable sum in thinning, and had an immense heap of brush piled rotting in consequence; but it would, he said, cost too much, and after all, the forest, he thought, would succeed nearly as well without. It must be remembered that there is a danger in thinning not generally remembered, that is, in dragging the trees out the tender bark of many young trees left standing is injured. This is noticed by some British authorities, and the advice given to cut and let lie—a thing disliked in America for fear of fire, and indeed in some parts of Britain too, especially where dry heath abounds. The fact is that, as soon as the heads touch, and the ground is well shaded, there is no harm in thinning, and if the proper time be taken, there is great good. But one thing after another too often takes up the attention of the planter; he leaves the trees untouched till they are unmanageable, then thins out with great difficulty and injury, or leaves them for nature, not always with success. For although nature does indeed thin her own forests, it is where she has sown forests, and our planting and her sowing have not always the same result. I must remark, however, that a forest may be thinned, according to a method common on the continent, when the trees are quite large, with speed and no injury. But it is done by men trained to the work, each tree being carefully felled, and if necessary, in parts.

THE FOREST OF DEAN.

Leaving the Colonel, I journey towards the Forest of Dean, passing by the historic city of Gloucester, famed for antiquities, and the more modern one of Cheltenham, once celebrated for the supposed power of its springs in renewing health, and here, (the only city in which I saw them) are noticeable the rows of wheeled chairs, waiting by the walls as on a cab stand, each with its chairman at the side, expectant of the fare. This is said to be the mildest air, though not the most southerly point, in England; the profusion of roses and flowers of all sorts in the gardens is immense, and the beauty of the gardens which front the numerous little villas is something surpassing what I have seen in any part of the world—far surpassing, for instance, anything noticeable in Virginia or other southern states of the American union. With us in Canada, flowers indeed will often grow well if

cultivated ; but here they grow and flourish by the thousand, cultivated, it seems to me, or not. Every street, even the business ones in many cases, has its row or its double row of trees, and when there is need of shade, which did not happen in my time, Cheltenham must afford walks delightful indeed. Here, too, a step brings you into the country, and there is many a path across farm, field and coppice, free to all, a matter in which England is a land of far greater freedom than America. There you do, indeed, often cross your neighbor's fields ; but his crops stay your progress. Here the farmer must not plough up these paths ; they are ancestral ; their grandsires walked there ; their grandchildren will. It is pleasant, too, to be in a land not dried to death like America, where her forests are gone. Here, where trees are many, and every here and there a wooded park, now and then a planted hillside, there is, also, many a pleasant running stream, many a rustic bridge, many a pond which all the year gives water to the thirsty herd. How different to the half dried creek, muddy and with sun-baked banks, which alone overclearing and lack of planting has left us at long intervals throughout Ontario—Ontario, a land even in my memory blessed with springs, with running brooks, with little rivers beyond what any one would believe who passes the place of their former existence to-day, and finds that they are not. Many of these, by preserving the woods on some land which was uselessly cleared, might have been retained, and how valuably ! Some farmers are trying, by replanting, to restore their vanished brooks, and I have no doubt many will succeed. There is no reason why Ontario should not be as rich in vegetation as this country—as well nourished with summer showers—as well supplied with running streams, for I remember, and so does many an old resident, when it was both. Neither did it require that the whole country, or most of it, should be woods to give this state of climate, for when, in the backwoods, we had still full one-third of the good timber, the rainfall and shelter were as good as could be desired. But when it comes to leaving the land but one-tenth in wood, and drying up that little by letting in cattle, and also “cleaning up” every swale and swamp that held moisture, then those ill results—loss of fertility, land too readily dried out, scanty summer showers, half the former hay crop, uncertainty in the wheat crop, winter-killing, and a score more ills unknown while still a generous proportion of forest remained in the land, begin to make their presence felt, as they have in every country in turn where the fatal experiment has been tried. With the fine sunny weather we frequently enjoy in Ontario, could we but retain the ancient moisture of the land, restore the springs, revive the sources of the showers, what bounteous crops of grass and grain might once more be expected. It is, as the history of all nations proves, fully within our power, if we will but plant the tree and care for the forest. But we must leave Cheltenham, and travel by rail to the Forest of Dean, our destination being the Speech House, an ancient mansion, now an inn, and one which Falstaff could well have “taken his ease” in. Thick stone walls of former centuries, archways, sculptures with the crown and initials of former kings, notably the second Charles, under whose *regime* the house was built—this has been a royal forest since the days of Edward the Confessor—great stone paved halls, store of black oaken panelling, with many a set of antlers overhead—this is the central point for those who come to the Forest of Dean, which has been thus described by a resident—I think the well known writer, Captain Mayne Reid, who lived for many years on the borders of the forest. (This

part described is on the road up a hill from the station to Speech House. The path is all the way through dense forest, and is most romantic. This path was cut, and stone paved through this forest—forest ever since,—by the Romans over 2000 years ago, and still is very passable. I wish we had a Roman Legion for a while at the same job in Toronto, with power to crucify contractors when expedient.)

"We are in the heart of the old *old* Forest. The waters of the Cannop Brook retained by a dam, nearly a mile below, spread out into a deep dark mountain tarn. From its margin, two great hills, wooded from water's edge to summit, rise high into the floating clouds, shutting in the view; on our right the open oak woods sweep upward; Beechen Hurst stretches far on the left. Above, below, around, forest, and forest only; hills in bold slopes, in jutting cliffs, in crags of weathered rock; gully and gorge, rippling stream and trickling rill; the sturdy oak, the light and feathery silver birch, the spreading beech and bright green arrowy larch, the dark holly, the ancient yew, the hazel and the maple; and below the venerable thorn, the clinging ivy, and the climbing woodbine, the tempting fern brake, the golden glowing bloom of fragrant gorse, the mossy turf still strewn with autumn leaves, through which the primrose, the violet, the wood-anemone, the ranunculus, and the blue-bell peep; the distant sheepbells tinkling their soft-soothing chime of peace; the song of the thrush, the blackbird and the linnet; the call and cry of many and unknown birds ringing from the thickets; the air, though fresh and bracing, yet rich with the perfume of the flowering hawthorn—all tell us that we have found the woodlands, the very woodlands of our early day dreams, where nature reigns, where there is rest and quiet and recreation for the worn body and the weary soul.

The ground we tread upon is hallowed; we are here in Ancient Britain: in Britain as it was two thousand years ago, and we know not how much farther back in the pre-historic past. This Roman road was made by that famous Second Legion, which for four hundred years was stationed at Caerleon-upon-Usk, twenty miles west of us, and then known as *Isca Silurum*. These roughly trimmed cubes of hard grey sandstone were hewn and carried here by British bondsmen toiling under the rods of the sappers of the Second Legion. The road between the curbstones measures nine feet, long distances of these curbstones being left unmoved by the traffic of two thousand years; between these was first paved, (much of which still remains, though many stones have in the twenty centuries been carried off for building,) over this was probably smaller stones like our macadam, meant to be occasionally replaced. The upper is long gone, but much of the lower still remains, and is so well laid, and is so extremely hard, that with patching they answer well for all the traffic yet, not heavy, for railroads run near all the mines, and there is little agriculture here."

The forest is managed by an ancient court, called the Verderers of the Forest of Dean, who were originally appointed by Canute the Dane, under the Forest Laws passed in 1016. What these laws of the forest were, and what powers the Verderers possessed to punish "trespassers of the forest, the vert and the venison," we are not told; but in the days of Canute, the Verderers possessed the power of life and death, that is to say, the power of stripping a man of his skin, and nailing it at the door of the court house as a warning to other trespassers. They had power to impose a fine of 10s., that is to say, over £20 of our currency, upon any freeman who should hunt one of the king's deer till he should be blown; but the serf was ordered to forfeit his skin for the same offence. The verderers were paid for the performance of their duty by commission, under the great seal to "hunt, harry, and kill" the deer of the forest, and to appropriate a buck, or sometimes only a half, for themselves. All except these were reserved for the royal table, and without the king's authority no deer could be killed in the forest. At present the emoluments are *nil*; the office honorary; but from its antiquity and associations it is still held in the highest consideration, and the contest which takes place, when a vacancy occurs, produces an excitement second

only to a parliamentary election. The venison is gone—the vert only remains—but the verderers still hold their ancient court in the heart of the old forest,—a court, perhaps the oldest in the kingdom, which in some form or other, has been held for the last 2000 years. A singular feature in their constitution is, that no lawyer is allowed to practise there, and a story is told of one who, irate at being ordered away, went off declaring he would show them whether they could exclude him from any court in the country ; but he never turned up again at the Speech House.

We must premise, in our description of British forests, that up to a late period—even up to say thirty years ago,—oak was thought to be the all necessary wood for England—for the navy. But when iron began to be used, the need of oak largely disappeared. For a time it was used for the backing of iron, but even this failed to preserve its use, as in contact with iron it creates a peculiar corrosion, from which the teak wood is free, and therefore this latter wood, even for this purpose, has taken the place of oak. Still, good oak has its uses, and keeps to some extent saleable. The Forest of Dean, originally a pure oak wood, is still principally devoted to that timber, and we shall now attempt to describe it.

Imagine a forest of oak trees, ten miles across and fifteen miles in length, but not a level forest. Through it in some parts, beside it in others, run the rivers Severn and Wye, and a multiplicity of smaller tributaries, and each river and each tributary has a deep valley and high flanking hill ranges of its own. Look from what side we will, our view is still of a succession of wooded mountain ranges, those nearest clear in all their multitudinous ocean of waving leaves ; those farther less clear, those farthest closing the view in dim and cloud mixed outline.

It is not all forest. There are some villages, and even a small town or two ; here a limestone quarry, deep excavated by the way side, here a colliery, its ever extending heaps of rubbish, earth and stone rising like miniature mountains ; while above, always busy, the stream of carts from the pit mouth deposits more and more ; here an iron mine, the ore ever ascending the shaft, the smelting furnaces ever at work above, the slag running red-hot to the cars which carry it to the rubbish heap. By the way, the Romans, those unconquerable workers, left here vast heaps of iron cinders, from which they could extract no more iron, but which modern ingenuity works profitably to the present day. And along the roads when work is done, we see here and there on their way to villages the iron workers, their jackets red as blood with ore dust, and colliers, as black as the first are red.

Then, too, here are chemical works. Vitrol is made in immense tank-like receptacles of grey metal ; pyroligneous acid and naphtha are manufactured ; charcoal, too, is produced in large amounts. Here and there, also, are private properties, farms and villas not a few. In fact, of sixty thousand acres once forming the forest but twenty-two thousand remain altogether in the power of the forest commissioners, and of these they have been able but to keep fifteen thousand acres in solid and governmental forests, where the ancient rights of the “free miners of the Forest of Dean” give them no claims. But village and town, mine and field, are so surrounded and hidden by forest, public and private, that the domain of the leaf is large indeed, and for all climatic purposes must be very beneficial.

The history of the forest is unique. It has been destroyed, reforested, bought, sold, and again obtained by the crown. In his need of money, Charles the First sold it altogether, and the buyer almost ruined the forest by selling the timber. The parliament of Cromwell seem to have ignored the sale and seized what remains were left, while Charles the Second, (let us allow that he in this did at least some good in his day), planted very largely, and again made a forest from the desolated remains. After him, however, was a period of carelessness, and the present century saw the forest in a poor state. The British Government have since done much to aid affairs, and about the commencement of the present century a very large number of acres, previously deforested and wild, was planted again.

This was not done without much trouble. The miners had rights secured to them of free forestry, so had others. But by dint of bargaining, giving up here and there a portion, and here and there securing one, the present magnificent forest has been retained, and is carefully preserved.

The government are of course, the prime movers in the matter, but of ancient usage, there is the Court of Verderers, previously mentioned, who meet once a year in the forest at the Speech House, who have a certain right to be considered, and their rights are conceded. Sir James Campbell, of Parkend, is what is called deputy-surveyor, and is in fact, the manager of the entire forest. He is most courteous, and sends his chief assistant, James Johnson, Esq., of Bromley Lodge, Ellwood, Coleford, Gloucestershire, to spend some days in explaining the economy of the forest to me. In his company, now trudging through long lanes cut in the forest, and wet till afternoon with heavy dew, now taking further excursions by wheeled vehicles, we travel for days on days through this great forest, in the heart of England, much of it good soil, and the one reflection ever present to myself is, "Why, in Canada, do we not take care to maintain, as settlement advances, many such reserves?"

Mr. Johnson is a native of the forest, takes pride in it, and is an enthusiastic believer in the value of woodland to a country. He fully explains, as we proceed, the plan of management. There are many large portions—in fact the chief acreage of the forest—which have been planted since 1800. Every year since then, planting has been more or less performed, and at present, and for years past, the average is ten thousand trees planted a year. These are not placed in separate plantations, but employed to fill up gaps in the forest as trees are felled, or to fill up now and then, a small piece as yet remaining unplanted by a roadside. The following is a statement of the time of planting and enclosing, compiled by Mr. Johnson :

DEAN FOREST PLANTATION.

Enclosed and planted previous to the year 1800, about acres	600
“ between 1809 and 1820, “ 	10,800
“ “ 1842 and 1872, “ 	3,200
	<hr/>
	14,600
Land not enclosed but planted with trees drawn from adjoining plantations, probably about acres	800
	<hr/>
	15,400

The number of trees on an acre in the old plantations range from 70 to 100, according to the number of times they have been thinned, the average probably being about 90.

The number of trees in the plantations since 1840, from 150 to 300, the probable average being 250.

In well kept nursery beds, occupying acres of ground, are growing many thousands young seedlings of oak, larch, Corsican and other pines. The larch and pine are bought of nurserymen when very young and planted here. They stand, as do the oaks, five inches apart in the rows, and in rows about fourteen inches apart. The oaks are obtained by planting acorns in the fall, transplanting the oaklings in eighteen months, and then, if required in the forest, five years more, fit them for the purpose, but if in the open, in three years they will be large enough. In the case of the larch and pine, of course, being much more rapidly growing trees, a much less time answers. But the general principle is to take from the seed beds (or rather from the first beds, as the larch are planted here, as stated), in the second year, and leave in nursery beds till fit for planting out. Large numbers of sycamores have been also sown, and are now as tall as the little oaks and larches, *i.e.*, from six inches to a foot. The nursery ground is soft and rich, such land as is near Leslieville, in Toronto, or in the Niagara and Essex peninsulas. It seems to me richer, though not softer soil, than that of the celebrated Douglas nurseries in Illinois, on the Michigan shore. The seedlings grow better here than any where I have noticed in Canada or the States; the rows have seldom, or never, a failing plant, and all are bright and vigorous. Beech is not sown; what is needed is taken from the young plants springing up in the woods. This is not done with the oak, as the superiority of the sown acorns in throwing out dense fibrous roots is very manifest.

The forest overseers number about fourteen, while of labouring men from eighty to a hundred find work winter and summer. Planting is all done in the winter, a thing which would not be easily managed in Canada. Much work is done in cutting and clearing out drains. A young forest needs good drainage; not at all so much the old, for the grown trees demand much more moisture than the small. This illustrates what has been often said of the immense quantity of water drawn from the lower strata by a forest, and dispersed by the leaves in air, thus equalizing the moisture of the atmosphere, and continuing the process of circulation which is the nurse of vegetation, whether in field or wood. At certain times of the year, hundreds of men besides these, are employed in bark stripping. This is done here while the trees stand; next year they will be nearly, though not quite dead, and will then be cut for timber, or for other purposes stated hereafter. The bark is stripped by the job, at so much a ton. Great piles were seen standing ready for shipment to the various factories of the buyers.

The trees are planted at first four feet by eight apart. They are not cultivated between, nor is the ground even ploughed at first; the young trees are planted as we would plant trees in a lawn; all will be rough grass, and a few spadefuls are turned and mixed where each is to stand. The ground, it must be remembered, is soft and rich. But the oak is a slow grower; in forty years the plantations are but of trees six inches through the trunk, and about thirty-five feet high. Much underwood, and even good-sized trees, grow among them. The land was not quite cleared, we must observe, many

saplings overspread it, and many roots were there which sent up shoots, hence the oak plantations are full of holly, beech, birch, and many other trees, which are not discouraged, as they serve a purpose to be described. When they arrive at a good height, say fifteen or twenty feet, they are cut down, and at the same time any oaks which are considered too close are thinned out. All the wood except twigs below the thickness of a finger is cut into lengths of two feet two inches, piled, and sold by the cord to the factories in the forest, for the purpose of making naphtha and pyroligneous acid. In this process much charcoal is of course produced, most of which is now used in the various forest factories, there not being so much outside demand for it now, as when charcoal iron was more largely made. For this purpose soft wood such as fir is of little use, but the holly, beech, oak, hazel, sycamore, and such answer well; these all spring up in coppice shoots again when cut, and can be cut again in time. The object is to keep a crop of oaks always growing, and in the meantime to produce and sell yearly quantities of valuable thinnings and bark.

Of late years in spring the oak foliage has been the prey of insects which cover the forest with their webs apparently in a week, and develop into swarms which consume or destroy the vitality of almost every leaf, so that now instead of the dark green foliage the trees should present, all is fresh light green—young leaves, in fact, thrown out at midsummer, the old being visible, if looked for, in all stages of demolition. This, of course, greatly weakens the trees. It has been suggested that the land is oak-sick, having been in oak for a thousand years, and in consequence much of the planting done yearly is in introducing other wood, principally the larch. Oak, too, since the navy ceased to use it, as said, teak being found better backing for iron, finds no such good market. Larch, on the contrary, sells well, and grows in one-fourth, or even one-seventh of the time.

I have seen no forest more beautiful than that of Dean. Many good roads, many lanes bordered by hedgerows rich with holly and hawthorn cross it in every direction, and still, as the traveller arrives at each mountain summit, he sees stretching before him an ocean of billowy foliage, filling the valley from near to distant ridge, while far below now and then appears the river, a silver streak among the leaves. "It would," said a forester, "take three months to walk leisurely through our lanes, and view our forest well." It is most valuable that in the heart of Britain such forests are preserved, and admonishes us in Canada, while it is yet time, to keep some forest reserves of our own. Here, within half a day's journey of busy London, the traveller can bury himself in a forest so deep and so quiet as to cause him to almost forget that there is anything but forest in the world.

The distinguishing characteristic of the Forest of Dean is its succession of wooded valleys. Below the observer will see an immense valley, extending to right and left beyond sight, bright down to the river and up to the opposite summit with fresh green leaves. Beyond this is visible another ridge, densely wooded as the first, and again another wooded ridge, but indefinable in the remote distance, closes the view. Here and there these are diversified by many a vast rocky precipice standing upright out from the slanting hill, with oaks and beeches nodding from these natural battlements, ivy climbing their sides in its wildest profusion; and great low-spreading trees of yew and holly, each sometimes three feet through the stem, alternately sombre and lively below.

Yet we must leave the Forest of Dean for the roar of London, the continual noise of which, in the city proper, is something terrific to a new-comer, though old residents never hear it, they say, at all. But my bedroom faces a stone-paved street whereon, night and day, a thousand cabs, carriages, omnibuses follow each other to and from Waterloo station close by, while right overhead, a little distance down the street, a viaduct crosses, over which every now and then, with fiery glare and startling roar, a train goes full speed to its destination. In the day the sidewalks are almost blocked by the crowds of passengers which continually pour by; the roads are so full of vehicles that at no point can you cross without watching your chances carefully; and all this rush, this crowd, these trains, are being imitated over an area of many square miles around you. Seeing the crowds in the streets one is tempted to ask if any one ever stays at home in London—the whole population appear to have sought the streets. And those streets, lined with stores and warehouses, banks and counting houses from end to end, every street, we may say, piled each side four stories high with valuable goods, give a picture of wealth and the rush for wealth not to be seen elsewhere in the world. But we leave it for Egham, close to which is the abode of the Deputy-Surveyor—in other words the chief manager and superintendent of Her Majesty's royal forest of Windsor.

And here is Egham—its pretty and commodious tavern, with many a rustic, drinking beer in the bar and on settles in front of the house, many a “fly” in its stables, the great common and its big duck pond on one side stretching in front, the common every evening dotted with enthusiastic cricketers; and near here in a beautiful country residence, we find Mr. Simmonds, the genial and hospitable Deputy-Surveyor. Many a relic has he of the forest oak, among others, and chief, a beautiful desk, enclosing the great book of the Forest history, the desk complete being of the wood of Herne's oak, immortalized by Shakespeare, and unfortunately blown down by a great storm a few years ago. Here I stay a day or two, and see Windsor Castle, or at least as much as I—no enthusiast of sights—care to see. To the forest, however, I give some days, and Mr. Simmonds carefully gives me every opportunity.

Interspersed throughout the forest, are memorials, or what serve as memorials, of all the sovereigns of Britain, and of many of the statesmen whose wisdom added lustre to their reigns. Trees planted by the Georges, by the Henrys, by the Williams—trees in remembrance of celebrated queens—walks constructed by kings—all are here, and all point to the evanescence of life.

We do not here find a forest sacred to forest purposes, of growth of wood, or for climatic benefit, as in the parts under governmental management of the New Forest and of Dean. This is the pleasure resort of princes; it is stocked with game as the others are not, and it yields no such revenue—is meant to yield none such—from timber or from bark as they. Here all is meant for beauty—long walks of miles on miles, bordered by straight lines of such trees on either side, as Europe cannot elsewhere show, pretty lakes, shining like silver amid surrounding banks of heavy foliage, here masses of dark green firs, here the lighter deciduous trees, the white-stemmed birch, the spreading beech, the waving chestnut; here again the banks are broad sweeping terraces of brightest grass. But we will proceed to give more careful description of—

WINDSOR FOREST.

A beautiful little lake, called Virginia Water, is bordered on all sides by Windsor Forest which, either in open park or dense wood, stretches miles on every side, across it in any direction being at least ten miles. Here great care is taken to improve and perpetuate the forest. It is also intended to add to it by planting many thousand acres of the open heath which exists within the borders. About ten acres are now in young seedlings. Three acres have just been trenched with spade nearly three feet deep, to add to the seed-bed, and many acres have been already planted thence in rows three feet apart, and the trees eighteen inches apart in the rows. This is found at once to cover the ground, and soon kill the remains of the heath. The chief difficulty found in preserving young plantations is that when the heath is dry it is readily burned if ignited, and this frequently happens, being principally caused by pipes. Many roads about twenty or thirty feet, or even more in width, carefully seeded with grass, traverse the woods in every direction to afford means of checking this. The fire, however, sometimes overleaps the boundary, in which case the efforts of many men are necessary to extinguish it, generally beating it out with branches or brooms. The seedlings are purchased, being principally larch, spruce, and fir, this class of timber being found to flourish best on the heath it is proposed to plant. Of late ten thousand trees have been planted yearly, but it is proposed to increase the seedlings till, shortly, twenty or more thousand trees can be put in every year.

This principally refers to the forest, embracing the heath, which in time, according to the plan now in operation, will be all forest. In the part more particularly denominated the park, there is yet another nursery for seedlings, and many acres of young trees in plantations, from three to six feet high, thriving very well, and now ready to be thinned, and to afford three-fourths of their number to plant elsewhere. These will be, as being in a more forested region, it is to be observed, much larger than those planted on the heath, when placed in their ultimate positions.

There are, in the forest, nearly a hundred men employed. All is kept well drained by open trenches cut through both wood and heath. The plan adopted here is not intended for immediate money profit, but the improvement of the woods. The method of choosing trees for cutting is to fell those which are observed to be dying at the top, thus leaving the more hardy and thriving in the woods. There are, nevertheless, many venerable trees allowed to stand, some being carefully fenced with iron, as being planted in the time of, and named after, some particular monarch. But in this, as in the other two great English forests, frequent as are, here and there, the old trees, some of them dating back, it is said, to the Conquest, yet by far the greater portion has been planted within the last hundred years, and even the older plantations date back but to Charles I., and William III. These last, too, have often been cut over, and now contain more oaks by far of one century than of two in age. The oak, in these forests, is a slow grower; even at a hundred years of age, it is not at its full maturity, and seems by no means the equal in size of the many goodly white oaks Ontario once had, but has no more. Many plantations of forty-year oaks are but from six to seven inches through the trunk. I do not think this necessary, but owing to the forests being planted in grass and left in grass. Had the fields been ploughed before planting and cultivated after, as is done in American planta-

tions, it seems to me the trees would have grown much more rapidly. I observed in Windsor Park a row of young oaks, planted with care, and the earth kept stirred around since planting, which had certainly made, to arrive at their present height of twelve to eighteen feet, double the progress of those which had merely been planted in a grassy forest, with a few spadefuls turned up around, then left to themselves.

The general aspect of this vast park is very beautiful. Its many deep forests, forming a continuous succession of large oak trees, interspersed with beeches and Spanish chestnuts of enormous size ; forests through whose deep ravines one may wander for months, and yet leave much unexplored ; its splendid avenues, particularly those of elms, extending for numbers of miles in straight lines, from one important point or prominent piece of scenery to another ; its many young and thriving plantations of fir, larch, and beech, showing in bright contrast against the older woods, are rich, indeed, to the eye. But what charms the thoughtful visitor most, is that there is no careless waste of trees, no thoughtless destruction of groves lifetimes could not replace. On every side is care and neatness ; all around the visible intention that whatever of beautiful, whatever of pleasant, is here for the delight of man, shall remain as pleasant and as beautiful for future ages, when the present owners shall long have passed away. The millions of infant seedlings in far extending rows, the broad plantations of nursery trees, the barren heath beginning to be broadly covered by larch and fir, their bright green tops everywhere showing above the red heather,—these things give pleasure to the forest lover. Hope inhabits all the branches, and rejoices in anticipation of forests yet greener, of avenues still more noble, than these. How different to the fate of many a Canadian forest, doomed, when axe and fire shall have done their worst, to remain a blackened waste, overspread by weeds and brambles, too poor of soil for agriculture, too poor for grazing, too poor for aught of earthly use, till centuries of rest restore the forest which a little care might have preserved, and preserved, too, with more profit than was obtained by the process which destroyed it.

But we must remember that a wave of forest thought may be said to have lately passed over the world. Here in Windsor, the foresters will tell you that if the replanting system and the care now taken had been commenced “when they came,” thirty years ago, “What forests these would ‘a been, now, to be sure.” More or less care has always been taken, but it is within the last decade that planting has been most busy, and the ten years to come will commence more, if the plan holds, than the last hundred. So in Canada, where Ontario, if not all at once doing all I should wish for her forests, is at least doing more than any of the other provinces or the American States, and is showing fair promise of further advancement. Her example is having its effect, and steps are being taken in the adjoining Province of Quebec, whose newspapers quote the work of Ontario a reason for action, to commence the work of preservation. It is but of late that the world, as remarked, has aroused to the necessity of forests, their value to climate, their benefit to adjacent agriculture ; and the awakening is destined, in both hemispheres, to produce valuable results.

It is to be noticed that planters, in this country, have a drawback little known in Canada. The rabbits, if allowed, will destroy the young trees. To prevent this, the

seedling beds and the large nursery grounds, are enclosed by galvanized wire netting, often supported by iron posts, often by wooden palings. It is well for those who wish to plant that the inventions of late years have supplied them with a material so effective and so cheap. The park is fenced, on the outside, with oak slabs, split from the log, about seven feet long, half an inch thick and five inches broad. These are nailed to scantlings on posts as we make an upright board fence, only that they overlap half an inch or so. Instead of a baseboard, a piece of galvanized iron, such as we use for roofs, a foot wide and in lengths of about ten feet, is nailed on below the slabs, overlapping them a couple of inches. This would be very serviceable if adopted on our board fences in Canada, where our baseboard not only continually rots, but rots the boards above. With this, of course, neither occurs.

While on the subject of these English forests, let us consider how valuable it is to the population around, and even in the part remotest from them, that they have been preserved and that there now exists a disposition to continue their preservation. It is but lately, since the railroad has penetrated every recess of the island, that access by the general public has been, in the case of the most distant and most quiet, such as those of Dean and the New Forest, practicable. Now, from all the large cities, one day brings the traveller into the heart of a dense forest, so dense, so apparently remote, that he can forget a city was. The wild deer,—not the tame denizens of Windsor, but timid as those of a Highland mountain—fled on our approach; the adder glided through the rich herbage at our feet, in the New Forest—all was for vast distances apparently forest, but in two hours we were in the centre of London again. Anyone who has made the experiment of how life-giving the change from the dense atmosphere of the city to the bracing air of the forest, must be fully sensible of the advantage conferred on the citizen by the opportunity of the visit. It should teach us in the New World, where we still have forest ranges,—forest ranges of vast extent, and on land never to be of agricultural value—to retain them while still they can be, at slight cost, retained. We have, within a reasonable distance of Toronto, large forests which, if not of such park-like grace as these, yet in their many interspersing and beautiful streams and rivulets, their hundreds of bright, placid wood-bordered lakes, their succession of plain and mountain, giving scenes of sylvan beauty now, and affording possibilities of future delight and usefulness, if the proper means be taken, not existing here. It is now the time to strengthen the hands of those who wish to preserve a proper proportion of these, and it is a matter not affecting, or for the benefit of, posterity alone. Within twenty years we shall either be enjoying the results of the care here suggested, or we shall be regretting that, in the localities best fitted and now obtainable for the purpose, the opportunity no longer exists.

But we must leave Windsor, and shortly the railroad bears us to the sea-coast at the south, and to Southampton, strangest of Briton's seaports to a Canadian eye, with its tall houses, the sides, back and front as well as the roof often covered with slates; its numerous and pretty villas; its immense bay or estuary, in the morning a broad ocean of deep rolling waves, by evening an immense expanse of mud, with a river, far seen in the centre, winding its glittering way, relieved against the great stretches of dusky brown. We are not yet at the Forest; we must journey by rail to Lyndhurst station, and then four miles by omnibu

to Lyndhurst itself—a most picturesque little town, where are old castellated houses, with churches whose exterior is grand in stone and their sculptured interior magnificent in marble—the finest I have seen in England yet; and inns, taverns, hotels, where, by the by, as all through this country, I pay double what the same class of accommodation would cost in America. The Hon. Mr. Lascelles, who lives here in an old mansion of the time of Charles, gives me letters to his subordinate officials, and under the kind and hospitable care of these gentlemen I spend some days examining the Forest, which is well worth examination. We must remember that, as in Dean, it is not all forest, nevertheless, there are nearly a hundred square miles of crown domain, mostly either forest or heath, and fifty miles or so more of private property, much of which is forest. Of all this great extent, indeed, but little is cultivated. On the private estates the farms seem few; it is mostly a territory very thinly populated—a territory of silent forests—of quiet grazing ranges whereon but few cattle live, of rolling upland in long succession of ridges, bounded by forest on all sides—you pass the forest—it is heath again, at long intervals a village, here and there a few arable fields, here a solitary alehouse, the sign 200 years old, then an interminable stretch of forest again. But we must give somewhat of its history.

THE NEW FOREST.

As stated, there are over sixty thousand acres of crown lands, between forest and moor, the latter of thin soil, fit for little but fir growing, and having in area about thirty thousand acres, while as much more is covered by woods, old and young, spreading, occasionally intermixed with private property, about twenty-one miles in length, and of a width of over ten miles.

The forest had been, till about a century ago, very carelessly used, but at that time very much planting was done, and to this is owing the principal oak and beech woods which now exist. Of course, it will be understood that many trees were standing, and many roots, apt to throw up shoots, were in the ground at that time, so that the woods are not of regular appearance, but here and there an old oak, or immense beech, with all around trees of a century old, that is, oaks not yet at their best or largest, but well-grown trees. Such groves as these extend over great surfaces, and leaving them, we come to large expanses of fir, larch, and in some instances spruce. This succession of woods, varied by hill, dale, and river, extends for mile after mile, broken by barren moors of great extent, or here and there the farm of one of the forest dwellers.

There is a large staff of men employed, but their labors are limited to draining, much of which is done, cutting out trees when mature, stripping bark, attending to road making, or seeing that unauthorized parties do not assume forest rights. As for planting or nursery growing, that is practically discontinued here, for reasons about to be narrated. About thirty years ago an Act was passed for the inclosure and replanting of much of the forest, and commissioners were appointed to see it done. The manner in which they set to work, however, proved very displeasing to certain residents, those, that is, who had, and through some of whom their tenants had, rights of pasture and so on, in the forest. It was plain

that, if forests were to be enclosed, young trees planted, and all cattle forbidden entrance, many of these rights of free pasture must cease. An agitation was therefore got up, for which was called the preservation of the forest, but should rather have been styled the preservation of the pasture, which has, for the time, been rather comically successful.

The commissioners had gone about their work on the principle, it appears, of clearing portions of the forest and replanting them successively, and thus, it was said, the ancient ornamental woods of the forest were being cut down, till nearly half of them were gone. It would have been difficult, any one who understands the matter knows, to proceed in any other way, for as to planting under the shade of numerous overhanging oaks, the young trees would simply not have grown at all. What was being done seems simply to have been the carrying out of a method very common on the continent, which would have demanded that every year a portion be cleared, and every year a portion planted, till the whole were gone over. The objection raised was that the forest was being destroyed, but the real objection seems to have been that the pasture was being limited, pasture it will be noticed, not in any way benefiting the general public, but shared only by those who had certain lands or rights within the forest. However, the agitation was effective, and it was forbidden that any more should be enclosed, and that all the "ancient and ornamental woods" shall remain open and uninclosed. The commoners were hereby allowed to turn out their cattle the year round (previously they had not been so allowed during winter, when, of course, the young trees will be most fed upon.) This stopped planting. It would be of no use to plant thousands of acres of young trees which hundreds of cattle would immediately destroy. It also stopped the natural reproduction of the forest thrown open, for the cattle eat down all young shoots. It has long been known in America that, to throw open a forest to cattle is ultimately to destroy it; but it was not so well known, apparently, to these Act framers. But we went through wood after wood where all undergrowth save holly was utterly gone—where the wood, in time, would evidently be nothing but holly—a most undesirable change. A tree of less general use, or one apt to form a more inferior forest for all purposes, could hardly be found.

The commissioners were not largely perpetuating the oak forest, but rather aimed to replace it in part by different trees, and to their work is owing the many beautiful expanses of fir, larch, and other trees which, luckily, they were allowed time to establish, before this odd system of forest defence was inaugurated. How wise they were in this, the produce and the sale proves, for of fifty thousand dollars received last year for the whole bark, fuel, timber, and in fact, all wood and its products sold, twenty-five thousand were received for fir poles—thinnings of plantations (young trees used for pit props) alone. When this planting was done, had it been increased to the amount possible, *i. e.*, the moor planted as has been described in Windsor Forest, the returns might by this time have been immense. But that benefit would have been slight compared to others. The great moor, now affording scanty pasture to cattle, in fact, when I passed I saw but two donkeys on the whole of it, would have been a forest. It is odd to observe that one of the arguments used against enclosing it was that the soil was so worthless as to be practically of no use except for the growth of Scotch fir—the very wood which figures so highly in the sales referred to. The value of the land, however, was not justly estimated. On many parts,

especially with the firs for nurses, other trees would have grown well, and the whole, by now, would have proved a very valuable source of revenue—a revenue which might have been obtained not only without injuring the beauty of the forest, but by adding to that beauty in exactly the ratio in which many groves of pine, larch, and beech are more beautiful than a broad extent of moor, red with barren heath and rough with useless and unsightly furze. It is a strange but not altogether an unusual instance of popular legislation directed to injure the populace for whose benefit it was nominally inaugurated.

The result is, of course, a stoppage of forestry operations in all perpetuating sense. It would be useless to plant trees for cattle to destroy, and useless to keep them out of plantations that young trees may spring up, when these same are probably under the existing idea of “preservation,” to be thrown open before the trees are out of reach for browsing. The forest commoners find their holdings benefited, no doubt, and many a rent may be higher in consequence, but the cattle fed, and apparently but scantily fed, are a poor return for the great forest that might have now existed, and for the sure destruction, in time of most of the old. The hoof mark of the ox is a symbol of forest destruction worse than the red cross on the tree. The cross painter will leave the young trees at least, the cattle will not leave one.

However, even at present, putting aside thoughts of what might have been, the forest forms a picture of great beauty, and is the resort of thousands whom the pursuit of pleasure or the hope of improved health lead yearly to its neighborhood. The expenses of management here are about fifty thousand dollars yearly, and the returns about \$68,000, leaving \$18,000 profit. It is to be noticed that, but for the fir planting which was so summarily checked, there would have been no profit, but a loss. It is to be hoped that better information will improve the regulations, and place this vast forest in a position of yearly improvement, rather than that of certain ultimate destruction in which its nominal defenders have succeeded in placing it. A medium course, which should fully preserve the ancient forest, improve it, and greatly add to it, is quite possible, a course which would double its area of growing trees, many times double its yearly profit, and perpetuate a beauty which now tends surely to decay.

That is to say, while clearing portions of forest yearly, it is quite possible to leave standing those trees which are not yet fit for cutting, and which it is valuable to retain. This course would have met the principal objections. But it is very probable that it was not so much a forest as a pasture that many objectors desired.

A paper by the Hon. Mr. Lascelles, presented to the House of Commons Committee on Forestry in 1887, will be of interest here, as giving his views on the Forest Regulations as now established:—

“By the Acts of 1877 and 1878 the rights of commoners were enormously increased at the expense of those of the public, and the matter now stands thus. Everything in the shape of forest management is put a stop to, excepting the mere thinning and maintaining of the plantations formed under certain Acts of Parliament. Thus there are to be seen by the student of forestry over 40,000 acres of waste land lying idle and worthless, which he will no doubt consider, might well be brought under cultivation by planting. But by clause 5 of the Act of 1877, no planting may be done there. He will see several fine old plantations of oak, planted for purposes of profit, which are not only ripe and mature, but which are going back rapidly, and he will wonder why the crop is not realized and the ground

replanted till he is referred to clause 6 of the same Act, by which he will see that the ground may not be cleared of its crop. Last and worst of all, he will see some 4,500 acres of the most beautiful old woods in the country, most of which are dying back and steadily going to "wreck and ruin." These woods afford the finest possible field for renewal by natural reproduction, and ought no doubt to be most carefully protected; but here again absolutely nothing can be done, and it is for these reasons that M. Boppe and Colonel Pearson are obliged to say that a professor of forestry can teach his pupils nothing in this forest. It seems to me to be so strange an anomaly that a Committee of the House of Commons should be considering the question of expending a large sum of public money in order to establish a school in which the science of forestry may be learned, while at the same time all practice of that science is, as far as possible, interdicted in the chief State possession, where it could be exercised, and where it is most urgently needed, that I have ventured to trouble the Committee with these remarks. I trust that it will not be thought that I desire to spoil the natural beauty of the New Forest for the sake of teaching forestry. It is far too beautiful a possession to be sacrificed on any consideration. In the case of the 40,000 acres of waste land, so strong an opinion was expressed by various witnesses before the Committee of the House of Commons of 1875 that the land was of greater value as an open space for a recreation ground than if brought into cultivation under trees, that although I think 40,000 acres a rather large "recreation ground," yet in the face of this feeling on the part of the public, and of the opposition which would be set up by the large body of private individuals who make a profit by cattle breeding upon it, I do not think it would be wise to undertake any more planting operations on a large scale in New Forest, even if the power were granted by Parliament. So, too, with regard to clearing old plantations.

"Having regard to the terms of the Act of 1877, passed as the result of a public enquiry, I do not think it would be right to clear away woods, ornamental from a distance or possessing other beauty, even though past maturity, but, I think, some discretion should have been left to those entrusted with the management of these woods, with the instruction, that the ornamental character of the forest is to be preserved. But as things now stand, it must be most clearly understood that this forest is, by the desire of the public, not managed in accordance with the rules of scientific forestry, but more as a vast pleasure ground combined with a cattle farm, and consequently it is useless to expect a good pecuniary return from it.

"The case of the old woods is different. These woods are, as there is good evidence to show, originally formed by "encoppicing" large or small areas, and leaving the self-sown trees to spring up naturally, only protected from bite of cattle or deer. They are, though decaying, a most marvellous example of successful tree cultivation by the mode of "natural reproduction." It is sad to see them dying out, when all that is required to preserve them for future generations is to imitate the wisdom of those who made them at first, and by simply protecting, by enclosing them, and removing dead trees, leave it to nature to perpetuate them. The Act of 1877, while it strictly enjoins that they shall be "preserved," provides at the same time, that nothing whatever shall be done to them except by planting trees in the open woods, which cannot be done with real success so long as the woods remain open to cattle.

"Woods cannot be preserved by letting them alone. Trees have their span of life, as have human beings. When their time comes they must perish, and if all the seedlings which spring up round about them are destroyed by grazing the land, then the wood itself slowly but very surely will perish. Those who framed the New Forest Act of 1877 desired first of all to conserve these old woods, but their zeal seems to have carried them so far as to defeat the object they had in view; and I cannot but think that, had forestry been a science commonly taught in the past, as I trust it may be in the future, owing to the result of this enquiry, no such clause could ever have found a place in an Act of Parliament dealing with woodlands."

SCHOOL OF FORESTRY AT COOPER'S HILL.

In London I meet Professor Schlick, late Forest Director in India, and now Principal of the Forestry School at Cooper's Hill, intended for the education of foresters for India, but to which other pupils are admitted. Prof. Schlick is strongly of opinion as regards Canada, that the best hope of preserving the forest lies in the establishment and maintenance of large forest reserves. I obtain letters of introduction from him to Prof. Marshal Ward, Professor of Botany at the college, and he himself shows me the buildings and explains the object and scope of the institution.

It is a large building—in fact one of the former palaces of the well-known Baron Grant—near Staines. Close by is the Royal Indian Engineering College, to which the Forestry School is attached, (they are, in fact, nearly under the same roof), and within a mile of Windsor Park. In the Forestry College itself the studies of botany, forestry, and entomology, are pursued; but the other branches, such as engineering, surveying, and so on, are carried on in the adjoining college.

Particular attention, from a Canadian point of view, is due to this Forestry College, the only one in England, as whenever the subject of forestry is broached, the question of the necessity of a School of Forestry in Canada is generally discussed, and it may greatly assist in future calculations to be aware of the actual character and work of such a school.

Here, in the first place, is a large room devoted to the purpose of a forestry museum, containing specimens from all parts of the world of whatever may be of benefit to this particular study. Here is wood, both from Europe and Asia, in all its forms of timber. Here are long stands and racks containing specimens of axes, grubbing tools, levers, sledges, rollers, and the many other tools used in forest operations. Here are models of celebrated timber slides, ways of holding and elevating timber from rivers to wharves, from wharves to saw mills. Then long ranges of glass cases line the wall containing almost innumerable products of Indian forests and specimens of Indian plants, their seeds, the food materials produced from them, their many different kinds of bark at different stages of growth; then forest fruits of all descriptions, so far as it can be preserved for exhibition purposes, and so on. Here, too, are numerous specimens of timber showing the effects of, and healing, or failure to heal, of wounds to trees, most instructive to pruners; injuries produced by insects, (a most formidable list), a large collection of injurious insects, and one also of wood injured by the various species of fungi. Besides these there is a herbarium containing an excellent series of both the conifers and the deciduous varieties.

One of the most interesting rooms is doubtless the botanical laboratory, lighted by windows specially arranged for microscopical observation. Here are large glass tanks—or rather small glass houses, for cultivating seedlings and plants at certain temperatures, thus giving in the room at Cooper's Hill the climatic temperature of India, Canada, or the Cape if required; also, for affording to plants an atmosphere more or less charged with moisture at pleasure. Here are means of measuring the growth of plants, for noting the effect of light or darkness on vegetation, and means of carrying out experiments to

determine the disputed question of the transpiration of water from leaves. Microscopes and many other appliances are furnished the students, and every opportunity given them for further examination into the subjects of which the various lectures treat.

The lecture-rooms are various, both large and small, with all those convenient modern appliances for teaching, unknown to former days; and by the way, Prof. Ward shows me a splendid series of coloured botanical diagrams, prepared and coloured by himself, a series which, either in size, number, or clear exactitude of definition, I have never seen equalled, or even approached.

Daylight passes in our examination of the College, the Professor leaves next day, and it is now too late to see the botanic garden which is being laid out, and from which he expects great results; seed beds, seedling plantations, and all practical methods of raising the chief forest trees, will be illustrated here. The garden will soon be fully ready for use.

Perhaps the best method of explaining the subjects taught will be to state the course of study, as set forth in the College syllabus:—

“The student begins work in September, and attends lectures regularly during two academical years. In engineering, he is taught the principles of road-making, and the building of forest bridges and other structures; he is also instructed in the practice and theory of surveying under the care of the Professor of Surveying. In his first year he studies for two terms under the instructor in geometrical drawing, and in his second year receives lessons in the keeping of accounts. To these subjects may be added freehand drawing and a modern language. In addition to these more technical subjects the student attends certain short courses in mathematics and in applied mathematics, under the professors of these sciences; he also studies physics in lectures as well as in the laboratory, entomology and geology. A short course on organic chemistry is now being commenced.

“The rest of his work consists in the special training of a forester; and it may be safely stated that there is no other centre in the empire where so thoroughly and excellently designed a curriculum for a forester or planter, can be obtained. The two subjects of forestry and botany are under the care of separate professors. Dr. Schlick lectures on forestry, dividing his subjects as follows:—In the first year he deals with the various soils, climates, and the regulating effect of forest on these; silviculture, artificial and natural woods, their tending, thinning, pruning, etc.; the protection of forests against man and other animals, and especially insects, and against injurious plants, climatic influences, etc. During the second year the student is instructed in the utilization of forests, the technical qualities of woods, the felling, shaping, transportation, etc., of timber, the utilization of minor forest produce, the preservation of wood, saw mills, charcoal, etc. He then passes to the study of working plans, and especially the arrangement of cuttings, surveying and mapping forests, measurement and determination of ages of trees and forests, and the method of regulating the yield of forests. The final course of lectures is on forest law. In addition to the lectures, the students also make occasional excursions, under the direction of Dr. Schlick, the neighbourhood of Windsor Forest facilitating this important object, and enabling the Professor of Forestry to make his teaching thoroughly practical.

“In botany, under the management of Professor Marshall Ward, the students are instructed by means of lectures, and practical work in the laboratory and in the fields and woods in the neighbourhood. The course in botany is designed to train foresters, not technical botanists; its aim is thoroughly practical, and directed to teaching the students exact and thorough knowledge of the life phenomena of the trees and plants which it will be their duty to rear, and take care of, and utilize in the future. Commencing with a short course of thoroughly practical instruction in the elementary biology of plants, selected as illustrative types of the vegetable kingdom, the young student is taught the use of the microscope, and how to apply it practically in examining the tissues of plants.

He is then instructed in the orthography and anatomy of plants, learning not only in lectures, but in the laboratory and the field, what the organs of plants are, and what they do, so that roots, stems, leaves, buds, bulbs, tubers, tendrils, thorns, become to him not mere abstractions, but objects on which his attention will be continually fixed as active parts of plants. The study of cells and their contents, of epidermis and stomata, of vascular bundles and other tissues; of wood, bark, cambium, and so forth, is carried on thoroughly, not only that the foresters may know the principles by which to classify and recognize lumbers and foreign products, and learn their uses, but also that he may understand what these various parts of the plants do in nature; how hardwood is formed, how the timber grows and may be improved, how wounds may be healed over, how the roots take up substances from the soil, how the the plant makes use of them, and so forth. The student concludes his first year's study in botany (in the early summer) by familiarizing himself with the names and systematic positions of the plants in the neighbouring fields and woods, especial attention being paid to the important trees and shrubs, and their relations to the forest flora of India.

"During his second year the student is instructed in the physiology of plants, how they feed, respire, and chemically change substance in their interior; how they grow, and are affected by light, gravitation, temperature, moisture, etc., how they are reproduced, hybridized, and so on; the effects of various agents in the production of wood, in influencing fertility, and so forth. The course is completed by the study of the diseases of plants, and especially of timbers, and how their ill effects may be minimized or healed."

The senior students occasionally visit the gardens at Kew, (by far the best for the purpose in Britain), to obtain practical information concerning the most important plants in order that, when they commence, in India or elsewhere, the work of forestry in earnest, the knowledge may be of service. They then learn forestry in a more practical manner than school affords, by visiting at the end of their first year, in charge of the Forestry Professor, Scotland, the New Forest, or the Forest of Dean. At the end of the second year they visit Germany or France to observe, for three or four months, the system of forestry carried out in the large forests of these countries, which tour is supposed to end the Cooper's Hill course, after which most of the students leave for the forest service of India, which of late years has become a most important department.

With this full information as to the working of this valuable educational institution. I leave the hospitable domicile of Professor Ward, to which we have adjourned after examining the College, and prepare to start for Scotland in the morning.

FORESTRY IN SCOTLAND.

It is one of the days of "accelerated trains," when the other roads are trying to beat the time of the well-known "Flying Scotchman," and are succeeding in doing so, and making the "Scotchman" do so himself. In fact, by dint of careful management and great energy, we travel from London to Edinburgh in seven hours and a half, a rate of speed which is making the newspapers predict all sorts of terrible accidents. As a matter of fact, however, the train seemed slow, not fast, to those who rode thereon, such was the extreme steadiness and rapidity of the motion, and it was only by observing that one could not see the ground at all plainly, or by noticing that the telegraph poles followed one another almost instantaneously, that the speed of the train could well be known. But we pass the border; Carlisle is far behind us, and now we notice what they are doing with trees in the south of Scotland.

England is well sheltered, generally, by the numerous large trees along the hedgerows and through the fields as stated, but large plantations of trees are not very numerous, though they are here and there to be seen. On the borders of England there seem but few even in the fields or along the fences, which are here of stone, and for miles we pass over the old border mountains, famous in song and story, but lifting their barren slopes towards the heavens, great reproachful witnesses against the hands which long ago deprived them of the forests that once crowned their summits and preserved fruitfulness on their slopes. As a consequence, the land here is undergoing that process of wasting away, both in hill and dale, which has proved fatal to so many fertile countries. But once we cross the border into Scotland, a different state of affairs appears. Here are still great ranges of mountainous hills, which have evidently for hundreds of years been able but to afford pasture for sheep, sheep, indeed, many in number—(we see every here and there the stone sheep-folds—round enclosures with one door, built round in shape that the snow may not drift and lodge as it will in a square; it blows round and blows out, they say here, in these, a useful thing, for our enclosure makers to know); but of very small numbers compared to the immense extent of pasturage it has taken to support them. This is fast being changed. Everywhere along the great hillsides are fine plantations of young firs, closely set, covering the grounds for thousands of acres in some places, for hundreds in others, and diversifying the immense brown slopes with vast expanses of dark green. Most of this has been done within twenty years, and some very lately, while the work is still proceeding. Some almost precipitous hillsides many hundreds of yards in length and height, which had been but three years back pictures of stony desolation, washed more and more into gulleys by every rain, are now covered from side to side, up to the summit, with little fir trees, set about two feet apart, and making the mountain face as beautiful as it had before been repulsive.

And still as we pass onwards to Edinburgh the same is seen, and it is evident that Scotland at least here is re-establishing her ancient forests. Where shelter from wind is so necessary, where the wasting effects of heavy rains, unstopped by plantations, are so destructive, one would have thought this means would long since have been adopted. But there were reasons why the borders were treeless. In *The Abbot* the owner of a border fortress says to his lady, "The hand of the industrious Fleming would cover these mountains with trees." "But," she replies, "the trees would be burned by the English foeman." Though this cause has long ceased, yet nations are slow to change their methods, and it is only within a hundred years or thereabout that planting has been largely general in Scotland, while even as yet it is not so common as many Scotsmen would wish. Nevertheless, great progress has been made. But we pass the borders; we are near Edinburgh, and soon that old city, the most picturesque in situation and surroundings which I have seen, breaks on the view.

The chief street runs by the brow of a great ravine. The street is magnificent in buildings and broad stone pavement; along the ravine edge are great monuments of the departed illustrious; across the ravine itself, once a lake, now largely gardens, the great grey castle rises, the summit of a great precipice, while rising as high, but less steep, street above street, the tall houses of the old town clothe the sides of the opposite hill,

Far to the right is city still, on the left are other hills crowned by other monuments, and more distant against the horizon is the immense range of mountains, of which Arthur's Seat forms an abutment. At night this vast amphitheatre of house and castle, street and monument, garden and mountain, spread before you, here in deep shadow, here relieved by a thousand twinkling lights, is a picture new to me in city scenery. I should like to see it when they adopt the electric light, at doing which, by the way, Britain is slower than Toronto. I did not see one in London.

But my business is not in Edinburgh, and by rail and ferry I seek St. Andrew's ancient town, with its long links sacred to golf, its cathedral ruins, mementoes of the mobs of the Reformation, its ancient towers of an era long preceding, when first Christianity appeared in the then pagan land, its fishermen and fisherwomen in multitudes mending nets worn by many a storm and black with preserving tar, sitting in front, smoking mostly the while, of rows of stone cottages dating to the sixteenth century, their stone steps trodden into hollows by the feet of many generations of tenants; and after a further journey of some miles I find Dr. Cleghorn in a mansion embowered in beautiful woods, woods worthy of so celebrated a forester, and pass with him a pleasant afternoon and morning in his study piled to the ceiling with forestry literature, and his rooms enriched with many a grizzly tiger skin, trophy of his Indian days. Dr. Cleghorn, it is well known, has been of all Indian foresters the most successful in preserving the forest in both beauty and profit—in fact, he was almost the inaugurator of that great Indian forest department, from which we now take lessons in forestry, and which is the nurse of foresters. We look through his beautiful garden, and traverse his valuable and well kept woods. "Foreign grown timber," says the Doctor, enters so keenly into competition with mine that I can buy timber cheaper than I can raise it. But that is not the question. Where I have land sheltered by woods, I can let it either for pasture or arable land much better than I can unsheltered land, and it will much better repay the tenant." There is no doubt whatever that much Scottish land long practically useless for agriculture, will (when the forests now growing give them full shelter, supplemented, as these will be, by many forests which will be planted ere then) be extremely valuable, and will repay those, or their descendants, who planted the sheltering trees, and thereby stayed the devastating torrents.

Wind and water are alike necessary to agriculture, but they are like other natural agencies, most valuable when controlled and guided, most destructive when carelessly allowed to gain pre-eminence.

From Dr. Cleghorn I receive letters of introduction to various Scottish foresters, and proceed next day to the Highlands, and arrive at the Forests of Athol, in charge of the Duke of Athol's forester, Mr. Macgregor. Close by the picturesque castle of Blair Athol, is the pass of Killiecrankie, celebrated as the spot where, in the full flush of victory, fell Dundee, known in history as a stout upholder of the Stuarts in Scotland, but far better known to the world as the Claverhouse of Old Mortality. Here, in the now roofless though strong-walled chapel, is the vault in which he was buried. Mr. Macgregor takes every care to inform me respecting these forests, in which we spend some days.

How different are the Highlands and their denizens of to-day from the wild scenery and wilder inhabitants, the mountain lakes, the inaccessible fastnesses, the numerous armed retainers, of which we read in tales of the last century. Excellent roads pass through them in every direction, railroads traverse the central lines, and at every point of interest stands, large, modern, full of resources, the hotel of the period, with its army of liveried waiters, its dinner of five courses, its magnificent parlours and luxurious bedrooms; its charges, well, about double what I paid anywhere else. They have, they say, to be excused extortion. Tourists come only two months in the year.

THE FORESTS OF ATHOL.

These forests, between the different points at which we examine them, are more than twenty miles in length, and cover, or rather intersperse, between two and three hundred thousand acres of the Highland country. There is a large nursery, in which are growing vast beds of larch and Scotch fir, with many deciduous trees, and many of these and conifers brought from abroad. The chief, however, are the two first mentioned. They are grown in beds without shades, and succeed well. The course is one year turnips, with plenty of manure, composted with road scrapings a year before. Then, the turnips off, the next crop is larch or fir seedlings, which grow two years, are transplanted two years, and then planted to replace forests or commence them. About three hundred acres a year are fresh planted with trees, four feet by four apart, and one or one and a half feet high. The method pursued is to cut down some acres, varying from five to much larger amounts, if there be but few trees on the land, and take all off, leave it then to lie fallow, and rot the stumps, for some years, three to twenty, there being no scarcity of land, and then plant again, changing the kind of tree from larch to fir, or *vice versa*, as they are found to succeed better so.

It is to be noted that these forests, though very large, do not cover this immense property; there must, however, be at least thirty thousand acres in planted woods. There will, no doubt, soon be much more, as space is plenty. One reason why many hillsides are left unplanted is not that it would not be much more profitable, but that tenants on adjacent farms owned by the same proprietor, have at present the right to graze their sheep on the hills. This, however, is an immense waste of land. Much of it, not worth a shilling an acre for grazing, has returned many thousand pounds sterling in trees. We pass five cuttings, where are lying many larches, peeled of their bark, (the larch bark, though not like oak, will tan the lighter leather), and ready to be carried away as lumber. There are not many acres in all, but even these give three thousand pounds this year. There is always sale for larch and generally for fir.

It is noticed, too, that the land around has been much improved. Where we passed many good fields of grass, fit for grazing or mowing, green and rich, are seen. When the trees were planted on the hillsides near, we are informed, this was much black heather or bare rock. Nothing more forcibly, in any of my journeyings through forests, has shown me the great value of forests in benefiting the adjacent land. These fields, their bare hillside,

would once hardly keep a sheep ; now, many acres being in tall larch forest near them, and themselves dotted with trees, they are rich with very fair pasture. They would not plough—it is largely rock ; but grass they grow well, where nothing but heather grew before.

These forests, the older ones, were planted seventy or a hundred years ago ; they are cut when necessary, that is, when mature, or before, if signs of rotting or disease are apparent. Disease occurs sometimes, being occasioned, it is thought, by the over closeness of the trees ; not that they were planted too closely, but that they were not thinned in time. Another cause, the great hurricane of some years back (the same which blew down the Tay bridge), threw down many thousands of trees, which were at once sold, and injured many others, which are being since picked out and removed. Every poor tree is also taken away—a reversal of previous operations. Formerly, when under inferior supervision, the best trees were thinned out and sold. Now, if the whole be not sold in a block on the piece being cleared, only those which are poor are taken, and the best left till the general clearing. The destruction spoken of, which laid the trees of great valleys as prone as the mower's swath, is being remedied ; everywhere the hills are bright again with the small evergreens which have been planted from base to summit. Thus, the beautiful glen and mountains of Bruar Water, which Burns found bare of trees and wrote his celebrated poetical petition concerning, was planted according to his wish, and was some years ago covered with tall trees, which were, however, nearly destroyed by the hurricane mentioned. The trunks were sold, the debris cleared, and now all will shortly be forest again.

THE HUMBLE PETITION OF BRUAR WATER.

My Lord, I know, your noble ear
 Woe ne'er assails in vain;
 Embolden'd thus, I beg you'll hear
 Your humble slave complain,
 How saucy Phœbus' scorching beams,
 In flaming summer-pride,
 Dry-withering, waste my foamy streams,
 And drink my crystal tide.

The lightly-jumping glowrin trouts,
 That through my waters play,
 If in their random, wanton spouts,
 They near the margin stray ;
 If hapless chance ! they linger lang,
 I'm scorching up to shallow,
 They're left the whitening stanes amang
 In gasping death to wallow.

Would, then, my noble master please
 To grant my highest wishes,
 He'll shade my banks wi' tow'ring trees
 And bonnie spreading bushes,
 Delighted doubly then, my Lord,
 You'll wander on my banks
 And listen mony a grateful bird
 Return you tuneful thanks.

The sober laverock, warbling wild,
 Shall to the skies aspire ;
 The gowdspink, music's gayest child,
 Shall sweetly join the choir,
 The blackbird strong, the lintwhite clear,
 The mavis mild and mellow,
 The robin pensive autumn cheer,
 In all her locks of yellow.

Let lofty firs, and ashes cool,
 My lowly banks o'erspread,
 And view, deep-pending in the pool,
 Their shadows wat'ry bed ;
 Let fragrant birks in woodbines drest
 My craggy cliffs adorn ;
 And for the little songster's nest,
 The close embow'ring thorn.

The wild beauty of these deep glens and overhanging mountains is not to be described ; it is altogether different from any other scenery I have observed. But here to me they have a peculiar charm. While elsewhere one may see great mountains enclosing sheets of water, picturesque, no doubt, but barren all—heath above heath, and rock piled on rock, here the hill slopes rise to the clouds and beyond them, for they shroud their summits, but from the peak down to the deep lake border, and spreading right and left on the hill faces out of sight, all is rich with waving woods. All trees are here ; there are great forests of oak, wide plantations of larch, firs in dark masses everywhere, silver birches without number. The forests of Athol give, in fact, specimens of all Scottish methods of hill forestry. They are being, as remarked, extended. The forester's opinion is that where land is worth two or three dollars an acre rent he would not plant it ; but then, he remarks, there is any amount of land on hand worth but a quarter dollar an acre, and we should plant that. Coming from a land where we plant little and cut much, it is strange to see people plant large expanses which they never expect to cut, for 80 years, the forester says, is as soon as he would make his final cutting of Scotch fir. But it is cheering to see that there are yet people willing to do something for the future.

In passing through the Highlands, the most important forests will be found situated near Perth, Elgin and Inverness, which three counties contain nearly 250,000 acres of forest, and throughout these the kind of trees growing varies to a considerable extent with the height above the sea. For instance, up to 300 feet the oaks, ashes, elms, and, in some places, beeches, grow remarkably well, but when we climb the mountain sides to the height of 400 feet, great dark expanses of firs and larches, with many a bright stemmed birch between, cover the slopes in all directions. The soil is evidently remarkably well adapted for trees, and the frequent moisture common to the region seems to supply them with all necessary to their growth.

Not everywhere, however, in the Highlands are forests given fair opportunity of growth. In many places the fences and gates which defend the forests are not used for

the purpose of keeping cattle out, but for that of keeping them in, so that it may be imagined the forests have little chance of perpetuation. In fact, the young trees and underwood are constantly, on certain plantations, destroyed by sheep and cattle, so that when the present mature trees are gone there will be none ready to succeed them. The whole must then, by the method previously described, be cleared, the stumps left to rot for a long term of years, and the forest, if another forest be desired, planted again. It may be mentioned that nearly everywhere on this side of the Atlantic, as far as I have seen, they cut down trees with a saw, not with an axe, according to our practice. It is very odd to see a newly-cleared forest without any stumps above the earth, all that is left being the flat round tables level with the ground.

Two beautiful forests, however, among others, are here conducted on a better principle, the one near Grantown and the other at Beaully. Here sheep and deer are excluded, the young trees are properly thinned by hand, and as trees grow mature they are cut down, and these forests, perpetually reproducing themselves, form splendid examples of how ready Nature is to second the efforts of the forester when he endeavors to grow a forest, and not at the same time expect a grazing ground on the same spot. It is not to be supposed that cattle need entirely be excluded from forests. It can be so managed, by allotting to them certain portions of the woodland at a certain age of the trees, that they do no harm; but their general and uncontrolled presence is ruin. It is to be remembered, however, that there are many factors at work here against the forest; the right of shooting sells high, grazing interests are powerful, and pecuniary necessities induce many a Highland proprietor to graze a forest on a hillside, or to let as a shooting ground a vast extent of land which, were the capital easily obtainable and the proprietor's needs not of the moment, would, in thirty or forty years, pay far better as a forest than in any other manner.

Fir timber is now about 16 cents per cubic foot, and larch about 30. The heath near Forres, celebrated in Macbeth, is now a forest, and would be well worth—that is the wood on it, it is fir—\$250 an acre to any buyer. Some forests of Scotch firs are held at \$700 per acre, and some of larch at \$1,000. These have been planted generally about 40 or 50 years. In cases of buying in this way, the wood merchant does all the work of cutting. Generally, in case of larch, he peels the tree for bark first. It tans light leather well. A cleared larch plantation, ready for carrying off the wood, looks like nothing so much as a lot of immense peeled willow switches, lying on the ground.

The plantations and forests in Athol, also, are well cared for. I traversed many of them, and saw no cattle or sheep and but a few deer. When we speak of cattle injury, also, it is but relatively. In Canada enough cattle to ruin a wood often have full opportunity of so doing; in the Highlands one sees few sheep or cattle in the woods, and sees an extent of woods which a few cattle can but little injure. It is where a proprietor of limited woodland encloses there a goodly number of beasts that damage is done. But, take the Highlands altogether, the traveller sees that here many woods are planted, many bare moors being covered, and much occasional profit obtained by the sale of wood.

SUMMARY.

In making a summary of this British examination the chief points, perhaps, notable, are as follows :

Though land is there, of course, very valuable for agricultural and grazing purposes, many large forests are maintained, partly for the home supply of wood, which is turned there to many purposes little thought of in Canada (namely, the making of naphtha, charcoal and the like), besides those of ordinary fuel and constructive purposes, partly for well-understood climatic reasons. But it is to be observed that, if these forests were for sale in small portions, as with us, they would surely be bought up by small proprietors and cut down as the forests all over America have been. It is owing to the better feeling of leading men of the community that the interests of private individuals have not been so subserved as to give them the opportunity of committing this injury.

The next point to be noted is that all over the greater portion of England the fields are separated by hedges, often tall and thick, often raised on banks, and that the fields are generally small. Along these hedges, singly or in rows, stand many fine trees of various descriptions, generally deciduous, often with the lower branches trimmed off some distance up the stem. Moreover, many small plantations intersperse the fields, placed, it is easily seen, where land was least valuable for grazing or the plough. Here a steep hillside is trees from base to summit ; there, an out-of-the-way corner, carefully planted, is rich with oak and chestnut ; here again some more enthusiastic tree-lover has devoted a good level field to timber trees alone. The effect of all this is that, travel as you may through the Island, you notice few places where the wind possesses its full, unhindered sweep over the fields. The tenants, individually, would often cut down the sheltering tree, acting on a principle, far too common in America, namely, " Let me hope that my neighbor will grow trees, and that my fields, devoted solely to grass and grain, will obtain the benefit of his adjacent groves." But the landlords, with a more intelligent and abiding interest in the land, preserve the trees. The value of timber there has, no doubt, somewhat to do with this ; but much is owing to the desire of the landlord to preserve his estate in order and beauty, as well as in mere grain-growing proficiency, and the result is the maintenance of a very large number of trees, and of a very fair amount of shelter to the principal farming portion of the country, not to mention the undoubted benefit derived from the better distribution of the rainfall which the presence of interspersing trees and plantations will occasion.

In passing certain districts of hilly land there, where stone fences, or no fences, were the rule, and where very few trees were seen, it was evident that the washing of the rain, there being no groves to hold back the water, for ages, has much impaired the fertility of the soil. These tracts were undoubtedly once forest—the Island being originally covered with woods, and then these hills and valleys, since injudiciously too thoroughly cleared, had a much better soil. I have seen precisely the same evidence in New England, where, as some of the descendants of the Pilgrims informed me, their ancestors cleared a heavy forest and had for many years excellent crops, but the mania for over-clearing prevailed : there as elsewhere, they did not leave sufficient forest to preserve due moisture in the land

and at present the soil is almost utterly worthless. That it had been different formerly is evident by the ruins of many rows of costly stone fences, the land being once so valuable as to induce dividing and sub-dividing into smaller lots, the whole being now apparently scarcely fit to support a dozen rabbits. In any land of hilly formation the destruction of all forest means the wasting away of the soil. Even on the prairies, when once the heavy, matted prairie grass, which took the place of sheltering forests, is gone, the process of the water carriage of the soil to the rivers immediately commences, and soon where once a hundred bushels of corn grew to the acre we must be content with thirty, or we must bring manure to replace what we have allowed to wash away.

That the practice of maintaining sufficient tree shelter is doubly and trebly remunerative, no one can ask more decided evidence than such an examination as I have just made of Britain gives. The crops raised there, both of grass and grain, in the latter far surpass, in the former enormously surpass, acre for acre, the best average of American produce. And as I find also in that country, in such parts as the borders between England and Scotland, where all trees have evidently been removed centuries ago, long stretches of washed, wasted, poverty-stricken land, as in America under similar conditions; and as I also find that in such parts as the Highlands of Scotland, where land long barren has been planted with trees and in forest for the last hundred years, the foresters in charge, most reliable persons, some of whom have lately given evidence before the Royal Commission on forestry matters, inform me that all land near the influence of the plantations has quite changed its character, and where it was utterly barren and stony it now gives good pasture, I think there is every reason for believing that the great overplus of their average produce in England, compared with ours, is not due so much to any different system or superiority of farming, as to the fact that the moisture is distributed and retained by the shelter preserved in the country.

I remarked that it is apparently not due to superiority of farming. To me an English field, save that it is generally sheltered by trees and almost always by hedges, looks much like a Canadian one. The harvests of hay and grain were cut as ours, by machines, and what ploughed fields I happened to see were no better, if so well ploughed as I have seen Canadian fields. For artificial manure I cannot speak, but as far as barnyard manure is concerned, I have often seen Canadian fields manured twice as heavily. But it must be remembered that it was summer, and they manure mostly in winter in Britain. Their rich grass land must afford large amounts of manure. Where trees are kept there will be adjacent grass, and manure is thence obtainable. Our people certainly seem to work harder and do more farming in a day, man for man, than theirs. It appears to me that the rainfall occasioned by the nearness of the Gulf Stream is retained and distributed by the tree shelter preserved in England, and that here may be found the principal cause of their better crops. Land in Britain, in short, seems much in the same state in which I remember land in Canada when much forest yet remained in its vicinity, preserving a richness and moisture we may search for in vain when the forest is largely gone. And here a word should be said about rainfall. Shelter is valuable in some countries, not to increase the rainfall, but to distribute it and to prevent its injurious effects. If Britain preserved no tree shelter, the heavy rainfall which would then occur at certain times

would wash the good soil away, as it has done in certain places I have mentioned. This I have found occur frequently in Canada, near Lakes Erie and Huron especially. We are more subject to it, as our soil does not seem to have the depth of English soil, and our climate is more parching, *i. e.*, tending to dust, which easily washes away.

Any one who has had experience in clearing American forests knows that a certain principal element in the life of the soil, the humus, the rich depth of earth which underlies the original forest, seems altogether to vanish from the fields after a few years cropping, where the acres are open to the sun and wind. A reasonable explanation of this will certainly be found when we remember that this humus came largely from the atmosphere, being the result of the rotting of many successive generations of leaves, which themselves owed their growth to the atmosphere principally. While the humus was in the forest, it could neither be dried up by the sun nor washed off by the rain. When we clear the land we reverse the conditions ; we allow the sun to beat on the bed containing it ; it is a substance of easy evaporation, and a large portion of it escapes to the air from whence it came. Then floods of rain passing over the land, carries the rest, being light, to the hollows, the rivers, and ultimately to the lakes or the sea. This fact alone is ample to account for the difference of English and Canadian crops. But what then, it may be asked, is to be done ? We must have fields, and cut down forest to procure them. Undoubtedly, but we should leave plantations interspersing, and trees here and there, as is done in the land into the practice of which I am examining.

The condition of superiority in English soil is largely maintained by the action of Government in maintaining forests, in that of large landholders acting on the same line, and in that of landlords throughout the whole country refusing to allow the cutting down of the numerous scattered trees and small plantations which everywhere dot the land, also their encouragement of the constant planting necessary to renew losses occasioned by use of timber. To produce the same result here we must look, it would appear, to our well-to-do farmers, who most nearly approach, with us, to the status of the English landlords, and to our governing classes, backed and incited to action, by the moral assistance of our reasoning and contemplating citizens, as expressed through the press and elsewhere. Much has undoubtedly been done in Ontario by the distribution of forestry literature and the establishment of forest guards, in both of which I am glad to notice the Province of Quebec is about to imitate our work. But much yet remains to be done ; we are yet but on the threshold of forestry.

I notice in American papers some criticism of an idea which should now be removed from criticism—the well-known influence of forest on rainfall. We are no longer left to conjecture on these matters. The Governments of Russia and India have had, for over twenty years, hundreds of experimental stations in full activity, and we now have the reports of their observations.

DUNES OF GASCONY.

Very great interest has frequently been expressed in the forestry operations by which the French government, working at intervals, when necessary, throughout the greater part of this century and a portion of the last, have succeeded in changing what was a desert of sand, over a hundred miles in length, on their coast, into a productive forest. Moreover this desert was rapidly passing inwards, and covering village, field and garden, insomuch that one of the first officials connected with the works used to fasten his horse at night to the spire of a church, which, long overwhelmed with sand, lay forgotten below. Eight or more miles in width had been already covered, and, as will be seen by reading the account given by Major Bailey, from whose interesting pamphlet these extracts have been taken, the sandy desert was in full process of rolling inward and devastating the whole district. The former desert, now a forest, employs a large population in forestry work, not to mention the population further inland, who would have long ago been forced to retreat before the sand-hills. An excellent lesson to be learned here, so far as applicable to Ontario, is that wherever wastes of soil, no matter how poor, exist, it is possible to grow productive and remunerative forests thereon. Nothing can be more barren than this sea-sand, washed clean from all vegetable matter by ages of marine trituration, yet on it the pine grows, and grows well. We have many a field in Ontario which produces nothing, yet would well produce trees. On the sandy lands of Massachusetts, down by Cape Cod and South Orleans, I have seen them sowing pine seed over many acres, in some cases dragging it in with the harrow, in some drawing a furrow, but in many cases on the light soil without any preparation, trusting to the rain to beat it sufficiently deep into the sand to ensure germination and give the sprouting roots a hold on the soil. Forests of considerable size are growing there sown in all three ways, and there appears little difference in the success of the different methods. There are many places in Ontario where pines or other trees (though pines seem the surest in taking on such land) might profitably replace a waste of sand, with here and there a scant herbage, neither fit for meadow nor pasture, thereupon. Even close to Toronto, in our own High Park, there are some seventy or eighty acres of grass, part of which, about the centre, is patches of blowing sand, each year widening, and which would in time, if not checked, ruin the whole expanse of grass. All of this, and such as this, were far better in trees. But the reader will find, in what follows, an interesting description of the most successful experiment, on the largest scale in the modern world, in changing utter and extending barrenness of sand into valuable forests :—

From the mouth of the Gironde down to Bayonne, a distance of some 125 miles, the western portion of the departments of Gironde and Landes forms a vast plain, about 18 or 20 miles wide, the soil of which is sandy and extremely poor. This tract of moorland (*landes*), which gives its name to the southern of the two departments, is inhabited by a population, formerly almost entirely pastoral, whose villages are scattered over it, and who cultivate scanty crops upon the fields surrounding their dwellings. But from time immemorial, and until comparatively recent years, the *landes* have been subjected to a never-ceasing invasion by sand, which, driven over the plain from the sea-shore, in the form of moving hills, called *dunes*, has completely covered a strip of eight or nine miles in width, and would, if unchecked, have ultimately laid waste the entire district. The aspect of the country, before steps were taken to improve its condition, must have been uninviting in the extreme; the *lande rase*, or barren moorland, stretching towards the

sea, was bounded by the *dunes blanches*, or white sandhills, which, rising near the coast to a height of some 230 feet, had already buried below them many a village spire, and their irresistible advance seemed to render certain the destruction of everything lying in their path. The church of Mimizan has been thus partially covered; and, at a short distance from the village, a mound was pointed out to us, under which lies a buried hamlet. The village church of Soulac was completely overwhelmed, but was disinterred a few years ago; and M. Lamarque told us that he often ties his horse's bridle to the top of a certain church steeple!

But this state of desolation no longer exists. The barren moor is now stocked with a nearly continuous forest of the cluster pine (*Pinus pinaster*), which, covering also the rolling dunes, has completely arrested their advance; and from various elevated points which we ascended near the coast, as well as from La Truc, in the forest of La Teste, the dark green undulating upper surface of the pine forest meets the deep blue of the western sky, and, looking landwards, there is nothing else to be seen. Indeed, throughout the many miles which we travelled by rail, by carriage, or on horseback, through this part of the country, we became weary of the monotonous appearance of these trees. They are, nevertheless, undoubtedly the saviours of the land. They not only avert the destruction of existing fields and villages, but also profitably occupy vast areas of sand-hills, and of the low-lying, marshy and unhealthy ground between them, thus providing employment for the population, who are nearly all engaged, during the summer months, in the collection of resin, and, at other times, in felling, cutting up, and exporting timber, or on other work which the forests offer to them. The people, however, still keep large flocks and herds, the guardians of which are to be seen mounted on stilts about three feet high, driving or following their animals through the dense undergrowth of prickly gorse and other shrubs.

The climate may be described as a mean between that of the Parisian and Provençal regions; the annual rainfall of from 28 to 32 inches, being well distributed, so that the air seldom becomes excessively dry, as it does during the summer on the shores of the Mediterranean; and thus, where the quality of the soil admits of it, a fairly varied vegetation is produced. But this condition is rarely satisfied, for the deep soil of the dunes is excessively poor, and the number of species found growing on it is extremely limited. Very few shells are found on this coast, the soil containing but little lime, and not more than from three to six per cent. of substances other than fragments of quartz. It is surprising to note what a luxuriant vegetation is produced under such circumstances. The cluster pine, which is mixed in places with a few oaks (*Q. pedunculata*), and a small proportion of other species, attains considerable dimensions; while there is a dense undergrowth, consisting of broom, gorse, heather, ferns, and other plants, which flourish on siliceous soil. On the old plain of the *landes* the sand is mixed with a considerable quantity of vegetable *débris*, and contains much iron, an impermeable stratum of ferruginous sandstone (*alios*), mixed with more or less organic matter, lying at a short distance below the surface.

The first works were undertaken here, in the year 1789, by M. Bémontier, an engineer, whose memory is honoured at Labouheyre by a bust, mounted on the same pedestal upon which, until the days of the Second Empire closed with the disasters of 1871, stood the statue of Napoleon III. *Tempora mutantur!* The Forest department took charge of the operations in 1862. But it is certain that the cluster pine either grew spontaneously in this region, or had been introduced, long before M. Brémontier's time; for in the old part of the forest of La Teste, near Arcachon, we saw trees which must have been 200 years old, and the process of extracting resin from which had apparently been carried on for at least 150 years. This pine, which now constitutes the principal wealth of the district, is eminently adapted for the use to which it has been put; it grows splendidly on the soil and in the climate of the south-west coast, while it possesses a well-developed tap-root and strong lateral roots, which send down numerous secondary vertical roots to force their way deeply into the soil, thus holding it together, and enabling the tree to draw its supply of moisture from a considerable depth; at the same time the resin which it yields is a most valuable product. Although the cluster pine is found north of

the Gironde, it is there much less vigorous and yields less resin ; while in the valley of the Loire it no longer grows spontaneously, and it there loses nearly all its valuable qualities.

A special law relating to the dunes was enacted in 1810, its principal features being that the State can order the planting up of any area which, in the public interest, requires to be so dealt with ; and that when the land belongs to communes or private proprietors who cannot, or do not wish to undertake the work, the State can execute it, reimbursing itself, with interest, from the subsequent yield of the forest. As soon as the money has been recovered in this manner, the land is restored to the proprietors, who are bound to maintain the works in good order, and not to fell any trees without the sanction of the Forest Department.

CONSTRUCTION OF THE WORKS.

The dunes are formed by the combined action of the wind and sea. Each ebb tide leaves a quantity of sand, a portion of which dries before it is covered by the next flow, and it is then liable to be blown away by the wind. The individual sand-grains, which are not, generally speaking, either sufficiently large to resist the force of the strong westerly breezes that blow from the sea towards the low plain which bounds it, nor sufficiently small to be carried away in the air in the form of dust, are driven along the surface of the ground, rarely rising to a height of more than one-and-a-half or two feet above it, until they meet with some obstacle which arrests their course, and thus promotes the formation of a little mound. Up this succeeding sand-grains are propelled, and on reaching its summit they fall down the sheltered reverse slope at a steep angle. In this manner sand-hills or *dunes*, rising sometimes to a height of 200 to 250 feet, are formed, the line of their crests being, generally speaking, perpendicular to the direction of the prevailing winds, that is, in the case of the tract between the Gironde and Bayonne, parallel to the general line of the sea-shore. This action is not completely regular. The formation of some of the dunes is commenced close to the sea, while others have their origin at some distance from it ; and fresh importations of sand either add to the bulk of those already existing, or, being blown through breaks in the chain, pass on till they encounter some other obstacle. But the sand-hills themselves are kept moving slowly landwards by the wind, which drives the upper layer of sand from the gently-sloping outer face up to the summit, whence it falls down the steep slope on the landward side, and this process being continued whenever there is enough wind to produce it, the dunes are moved, or rather rolled, inland by slow degrees ; and as fresh ones are formed near the sea, which are in their turn moved onwards, it follows that, in the course of time, the whole surface of the plain has become covered with sand-hills for a distance of several miles from the coast. The rate at which the sand thus advances is very variable. Sometimes, during many months, there is no perceptible encroachment, while at others the movement is very rapid, amounting to 60 or 70 ft. in the year ; the average annual rate is said to be about 14 ft. But the sand-hills do not move at an uniform rate of speed. Some, overtaking those in their front, become merged in them ; while they will undergo changes of height and form, so that the whole surface of the country is continually in motion, being turned over and over to a great depth, and under these conditions it is impossible to grow anything on it. The source of the evil lies at the sea beach ; and the first thing to do evidently is to stop fresh importations of sand ; while as regards the dunes already formed, it will be seen from what has been said, that the movement, at any particular time, is confined to the sand then at the surface, and if this can be fixed during the time necessary to enable a crop of herbs, shrubs, and young trees to be raised upon it, the movement of the entire mass will have been arrested.

We rode from St. Eulalie, through the forests, to the coast near Mimizan-les-Bains, where M. Lamarque explained to us that the system by which this is accomplished consists in promoting the formation, by the wind, of an artificial dune, close to the sea, and, generally speaking, parallel to it at high tide. This mound absorbs the fresh importations of sand ; while, under its shelter, sowings are made, which, extending gradually inland in parallel bands, fix and consolidate the surface of the naturally-formed sand-hills ; ulti-

mately the artificial dune is itself planted with trees, and the evil is then cured for so long a time as care is taken to maintain the works, which are commenced as follows :—

At a distance of about 165 yards from high-water mark, a wattled fence 40 in. high is erected, the pickets being driven 20 in. into the sand. This serves to arrest the sand, which is heaped up on the seaward side, a portion of it filtering through the wattles. After a time the fence is overtopped, and the sand, blown up the outer fence, forms a steep slope on the other side. A second wattled fence is then erected, about $6\frac{1}{2}$ ft. behind the first, and the space between the two becoming filled up, and a mound rising over it, the sand which falls over stands at a high angle against the reverse side of the second wattle. In the centre of the mound, a palisade of planks, also 40 in. above and 20 in. below ground, is erected—the planks, which are of pine sapwood, 7 in. or 8 in. wide, and $1\frac{1}{2}$ in. thick, being placed $\frac{3}{4}$ ths of an inch apart. When the sand drifts up against them, a portion of it falls through the intervals, thus affording support on the other side; and when they have become nearly covered, they are raised about 2 ft. out of the ground by means of a hand-lever and chains. This operation, which we saw performed, is repeated from time to time, until the barrier has attained a height of about 25 feet, when a third wattle fence is constructed, at a distance of from 5 to $6\frac{1}{2}$ ft. behind the inner slope; and the top of the barrier is strengthened by means of a line of small fagots formed of pine branches, gorse, and other shrubs, which are half-buried vertically in the sand. The fagots, each of which weighs about 45 lbs., are placed at distances of $4\frac{1}{2}$ feet from centre to centre. During the time that elapses before the last fence is overtopped, the palisade is not raised, so that the width of the base is increased, and the top becomes broader and rounded. When the palisade, which is now moved back a short distance, is overtopped, it is raised as before, an additional wattle being placed in rear of the work; and the building up of the mound by the action of the wind is continued in this manner, until it has attained its maximum height of from 40 to 45 ft., when its breadth is allowed to increase, until it stands on a base about 330 ft. broad. The foot of the outer slope is then about 100 ft. distant from high-water mark, the top being at least 165 ft. broad, and the slopes standing at 35 or 40 degrees. This result is usually attained in from 15 to 18 years, but the rate of the barrier's growth is by no means regular. Strong and steady west winds are the most favourable; but when the sand is raised by squalls, it is sometimes carried inland in considerable quantities. The artificial dune must be broad at the top, and its profile must be such that the most violent storms do not easily "take hold" of it; but if these conditions are fulfilled, its maintenance is easy and cheap; and if the base of the outer slope be kept at the prescribed distance from high-water mark, the sea, even if it reaches it during exceptionally bad weather, does the structure but little damage.

The surface of the mound is consolidated by fagots, 12 to 14 in. in circumference and 14 to 16 in. apart, buried vertically to a depth of 16 in. in the sand, and projecting 8 to 16 in. above ground. It is also sown with *gourbet* (*Arundo arenaria*), about 13 lbs. of seed being used per acre. This plant, which is a kind of grass,* with an underground stem and strong interlacing side-roots, has a remarkable power of keeping its head growing above the surface of the rising mound, the particles composing which are held firmly together by it. The sand subsequently left by the tide, either travels along the shore, or is taken up again by the sea and deposited elsewhere. An artificial dune, constructed in the manner above described, now extends along the coast for a distance of 125 miles, from the Gironde to the Adour.

As soon as the further importation of sand over the country has been arrested by the palisade, and the covering of the future plantations has thus been guarded against, the sowing of the ground in rear of it is at once undertaken. This is effected in successive parallel belts of about 20 yds. wide, commenced at the distance of 5 yds. from the line to which the inner slope of the dune will attain when it is completed. By beginning at this point, and working gradually away from the sea, the plantations are secured against injury by sand which has already passed the line of the barrier. If the sowings were begun elsewhere, they would soon be covered by the advance of the naturally-formed dunes over them.

The land to be operated upon is roughly levelled, and a mixture consisting of 11 lbs. of pine seed, 7 lbs. of broom seed, and 5 lbs. of *gourbet* per acre, is then sown on it broadcast, a palisade being erected at its inner limit, so as to prevent the seed from becoming buried under sand, carried over it by land breezes; this structure is moved back as the work progresses, so as to serve for the protection of other belts, as the sowing of each is in its turn undertaken. The sowings are carried on from October to May. The seeds are covered with branches and brushwood, laid like tiles or thatch, with their butt-ends towards the sea, and kept down by means of sand thrown upon them. The surface is thus temporarily protected, until the plants have had time to grow up and take hold of the soil. If the covering of branches is at any time disturbed by the wind, they must be at once readjusted; and should it be found that any damage has been done to the seeds or seedlings, the ground must be re-sown and re-covered with branches. The cost of the entire work is said to amount to about £8 per acre. We unfortunately did not see it in progress, but we saw some ground that had recently been treated in the manner described.

We visited the artificial dune of St. Eulalie—Mimizan, which is now nearly completed, and M. Lamarque explained the system to us. This barrier commenced eighteen years ago, is now about 40 feet high, and, all the ground inland having been sown, there is nothing but young pine forests to be seen as far as the eye can reach. What is now required is simply to maintain the artificial dune, which is done most scrupulously; and whenever any movement of the surface commences, fagots are at once planted, and the surface is re-sown and covered. This operation was being carried out in places during our visit, and we were assured that, if such precautions were neglected, the entire work would soon be destroyed. We saw, indeed, two instances where want of proper supervision had already produced this result. The first of these was a few miles south of Arcachon, where the land was sold, in 1863, to a private proprietor, who neglected to maintain the artificial barrier; and, consequently, a "white dune" is now in process of formation, and is gradually engulfing the pine forest established behind it. Some endeavours have been made to arrest the movement of the sand by the erection of wattled fences inland; but these are of no avail, and the trees are being slowly but surely overwhelmed. As we mounted the new dune from the side of the sea, we found the trees more and more deeply buried; and at its summit we actually walked over the crowns of some which were completely covered. On the land side, the sand falls down in a steep natural slope, at the foot of which are seen masses of young seedlings, carpeting the ground between the older trees from which they have sprung. It is said that nothing can be done to remedy this state of affairs, on account of the conditions under which the land was sold, but special legislation seems urgently needed.

The second instance was seen a little south of the Mimizan dune, where, the subordinate in charge having neglected his work, the wind got under the covering of branches for a distance of several hundred yards inland, and thus caused the formation of a number of large holes or pits with steep sides. If these were not dealt with, the whole forest would soon be destroyed. Matters have already gone too far to admit of mere local treatment; and the only thing to be done is to dig up the *gourbet* and other vegetable growth and allow the artificial dune to be breached, so that the holes may be filled up by the agency of the wind that caused them. But when doing this it will be necessary to erect a wattled fence on the inner side of the damaged surface, so as to prevent the sand from being carried too far inland. A fresh layer of sand will then deposit itself over the plantation; and when this has occurred, and the surface has thus been restored, the artificial dune must be re-formed, and the sowings re-made. We were assured that no other course is possible. This is an excellent instance, showing what incessant care and watchfulness are required to carry out an undertaking of this kind successfully.

The enemies of the forests are our old acquaintances the graziers and the fires; the former, mounted on their tall stilts, driving their flocks wherever grass is to be found,—that is to say, where the young seedlings are growing. It is said that article 67 of the Forest Code (which provides that grazing rights can only be exercised in those blocks which are declared out of danger by the Forest Department) cannot be brought into force here, which seems a great pity. Fires cause very great damage; for not only is the under-

growth of shrubs, and the mass of dead leaves and needles on the ground, extremely inflammable, but the pine trees themselves are so also. Conflagrations are sometimes caused intentionally by the shepherds, who desire to extend the area of their grazing grounds; but they are also frequently due to accidents, and it is said that they are sometimes caused by sparks from the railway engines. When they occur, they are most destructive in their effects. In passing along the railway, at a distance of a few miles from Arcachon, we saw a large tract which was completely bare, the entire forest having been burnt off it. Unfortunately there is no special legislation here, such as exists in the Maures and Esterel; and nothing can be done but to cut fire-lines from 30 to 70 feet wide, round, and at regular intervals through, the forest, so as to divide it into blocks of 250 acres each. These lines serve as roads, and as starting points for the counter-fires, which are lighted when occasion requires it, in order to prevent the spreading of the flames. On each side of the fire-lines, as well as along the main roads and railways, the undergrowth is carefully burnt off, so as to diminish the chance of accidents; and every third year the lines themselves are dug up and all roots are extracted. This work, which is usually performed by women, whom we saw using a tool something like a large Indian hoe, costs about 5s. per acre of fire-line. The trees are sometimes attacked by a species of fungus; and it is customary to dig trenches round those which show signs of this malady, in order to prevent its spreading further.

It is very difficult to give figures accurately representing the annual yield of these forests in cube resin, but it is put down at from 200 to 400 lbs. per acre, the price obtained at the factory being from 14s. 6d. to 16s. 6d. per 100 lbs. It is also stated that a tree, tapped so as to not cause its death, yields annually from $6\frac{1}{2}$ to 10 lbs. of resin, a very large one having been known to give about 16 lbs. Some figures relating to last season's sales in the Garteay and Pilat blocks of the forests of La Teste may prove of interest. The right to tap and fell, within five years, 7,528 trees, aged from sixty to eighty years, and constituting the final felling on an area of 118 acres, was sold for £1,592. This gives nearly £13, 10s. per acre, and a little more than 4s. and 2d. per tree. The yield was estimated to be 245,055 cubic feet of timber, 125,158 cubic feet (stacked) of firewood, 2,082 cwts. of crude turpentine. It must not be forgotten that the above is the revenue for the last five years only; previously to this, thinnings have been disposed of, and the trees now sold have been tapped since they were about thirty years old.

MANUFACTURE OF RESIN.

When travelling from Bordeaux to Arcachon, we left the railway at La Teste to visit a resin factory close to the station.

The crude resin, brought to the factory in casks, is, notwithstanding the precautions taken, found to be mixed with a certain quantity of foreign substances, such as earth, chips, bark, leaves, insects, etc. After adding about 20 per cent. of the solidified resin (*barras*), scraped from the cuts, it is heated moderately in an open caldron, so as to bring it into a liquid state, when the heavier impurities sink to the bottom, the lighter ones rising to the surface. The liquid resin thus obtained consists of two distinct substances, viz., colophany, which is solid at the ordinary temperature of the air; and spirit of turpentine, which is liquid and volatile, and some of which is lost if the caldron is overheated. These two substances are separated by distillation in the following manner:—The liquid resin is allowed to run through a strainer into a retort, a small quantity of water being introduced at the same time. The rising steam carries the spirit of turpentine with it, and both are, after passing through a refrigerator, caught, in a liquid form, in a trough placed to receive them; the spirit being lighter than the water, lies over it and is easily drawn off. The colophany is then allowed to run out of the retort, and passing through a sieve, is caught in a vat below. Thence it is poured into flat metal dishes, and allowed to harden in the sun, under which process the finer qualities attain a delicate amber colour. But there are several classes of this substance, distinguished chiefly by their colour, which is a guide of their degree of purity, and these are known by various names, and have different commercial values. The impure residue left in the

caldron is distilled separately, and yields rosin and pitch. The raw resin collected from the trees in the autumn is harder and less valuable than that obtained during the spring and summer.

We were told that, at the factory, 25 barrels (of 520 lbs.) of raw resin are distilled per diem in summer, and 16 in winter. The spirit of turpentine sells for 24s. per 100 lbs., and the colophany for 9s. per 100lbs.; but the purer kinds, for the manufacture of which only the most liquid portions of the raw resin are put into the caldron, fetch from 13s. 6. to 14s. 6d., the price of the finest quality, known as Venice turpentine, rising to £4, 10s. per 100 lbs. Comparatively small quantities only of the finer substances are extracted.

UTILISATION OF THE WOOD AND SUBSTANCES EXTRACTED FROM THE PINE TREES.

The effect of tapping the pine is to cause a flow of resin towards the lower portion of the stem, which thus becomes charged with that substance, and is rendered harder and more durable than the upper part of the tree. The resinous wood is used for various purposes; very largely for railway sleepers, when it is injected with creosote or sulphate of copper. We visited a factory at Labouheyre, in which the latter substance is used for injecting sleepers and telephone posts; and the superintendent assured us that, for pine wood, it is much superior to creosote. We saw many thousands of injected pine sleepers at this and other railway stations, and were informed that they are largely employed on the lines. Planks and scantlings, of which a large stock was lying at Labouheyre, are sent for sale to Paris; while poles, extracted during thinnings, are used as telegraph posts, and mine-props. Last year when we were in the Cevennes, we found that mine-props from the Landes were employed there. Charcoal is also made in some forests.

On our way from Labouheyre to St. Eulalie, we visited an establishment for the manufacture of pinoleum, or pine-oil, which is used as a preservative for wood, and also, when prepared in a special manner, for burning in lamps, as a substitute for kerosene. The machinery was not working, and we were unable to study the details of the system; but the light given by the oil, which is made use of to a considerable extent in that part of the country, is very good, and it possesses the great advantage of not being explosive.

EUROPEAN FOREST MANAGEMENT.

It was impossible this year, within the three months devoted to the journey, to add to the work of examining into British forestry that of an exploration of the French and German woods, in order to state the methods in use there, and obtain, if possible, some valuable hints for Canadian practice. This may, however, be done in some future time. The forest there is under such different conditions from that which grows within our borders, that much care would be necessary in attempting any adaptation of their system. For instance, any portion of forest here, once secured under deed in private hands, is at the entire disposal of the owner, who may cut it all down if he choose, no one having any legal right to object to the process, however the owner may (say by clearing a mountain and allowing the rain water, which the wood formerly held and allowed gradually to descend to the plain, wash away the good soil for all time, and choke with *debris* the stream below; or by taking away the woods which formerly preserved valuable streams, dry them up, and destroy both the water-power and their value to the agricultural country through which they pass) injure the rest of the community. But in Europe this is very different. In Germany, it was lately stated before a committee of the British House of Commons, a private owner must obtain leave of the Government before cutting down his

woods ; and in France, so strict were the laws passed some time back that, if an owner cut down his forest without leave from the authorities, he was compelled to replant it at once, and pay a heavy fine besides. In the more northern parts, such as Norway and Sweden, it is stated, for each tree cut down two must be planted, the idea being to extend the present forest over waste places, and also to furnish an overplus of young trees, as a set-off to loss by cattle or possible death of saplings in other ways. There is another very great difference—that is that, in many European countries, where coal is scarce and wood the principal fuel, no difficulty is found in getting rid of the branches and chips left by foresters when getting out timber. Any one who is acquainted with the method of doing this in America, (where the whole ground for miles is often covered with piled brushwood, rejected logs, and tops of trees, lying in all directions, mingled with great heaps of chips, all giving every chance to any fire which may arise from pipes, abandoned camps, or even lightning which often causes bush fires) can see at once how the opportunity of getting the rubbish cleared away by the surrounding population diminishes the labour of forest management, and reduces the danger of loss by fire. This is not the case where coal is plenty, or where large logs, otherwise worthless, are obtainable free for fuel by the peasants. In the Highlands, for instance, I saw many heaps of stout branches along the lake shores, and was told that they would hardly be carried away, though the people were free to do so. “We shall most likely have to burn them in spring,” said the forester.

In all forestry literature, I have not found the European methods described in a manner which would give a Canadian a thorough understanding of the process employed ; but trust, if able, to give such a one at a future day. In the meantime, an excellent article from the pen of Mr. Fernow, United States commissioner, is quoted below, and gives many points of interest, which may be valuably studied by those who desire to see the management of our forests improved in the direction of the European model. It is not to be supposed that this can be done at once, but a view of the carefulness exhibited in other lands, compared with what has too often been the reckless waste of American axe-men and foresters, may have a beneficial effect. It is too often supposed that care is taken of wood in Europe because it is so valuable there compared to its price here ; but this is a mistake. Forests are encouraged, and trees by the road preserved, where timber from America can be bought cheaper than it can be furnished by the proprietor of the trees. That proprietor can often go to a saw mill, get a piece of American or Norway timber, and have it cut into proper size, cheaper than he can cut down his tree and get it cut up at the mill. They preserve the woods because of their known benefit to agriculture, and especially to cattle growing ; not to let, as is the careless custom with too many here, the cattle into the woods ; but to give them the shade the borders afford, and to obtain the increased yield of grass adjoining woods encourage. The following is Mr. Fernow's article :—

We hear much reference to the excellent forest management prevailing in European countries, and on the other hand, the statement that the application of such management would be impracticable with us, and that we cannot learn much, if anything, from European practice. Both statements, I fear, are mostly made without definite knowledge of the subject, and without proper consideration. It would be of interest, therefore, to briefly state what the principal features of European forest management are, and wherein its introduction is unsuitable to our conditions.

We shall have to discern between forest management by the state and by individual owners. The former, which attempts, and, to some extent, represents, an ideal forest management, is carried on upon considerations of the general welfare, of continuity and regularity in material supplies, and upon other considerations of national economy; while the private forest management, imitating mostly the methods of the state forester, works mainly for the highest profits, and only to a limited extent recognizes the desirability of a regular and continuous revenue from the forest. Of course forest management is differently developed in the various states and portions of the same state, according to the general development of the country and its local needs. While in north-eastern Prussia, where forest land abounds and population is not very dense, the management is more or less crude, in the western parts a careful and intensive working of the forest takes place. In general we may say that in Germany, and especially in Prussia, Bavaria and Saxony, the science of forestry is the most highly developed.

The essential features of a well regulated forest management, and the principles underlying European, especially German, state forestry, may be briefly stated as follows:—

1. Forestry is regarded as much a business as agriculture ; it means the growing of a wood crop.
2. A proper economy in a densely populated country requires that all the agriculturally valuable soil should be, as far as possible, turned to agricultural use ; the wood crop is, therefore, the crop with which to utilize the poorer soils ; agricultural lands devoted to forest growth are becoming a rarity.
3. A proper economy requires that every portion of the land be made productive ; therefore, when the crop is utilized, a new crop is planted or its natural reproduction is secured.
4. Different timbers have a different capacity for reproducing themselves naturally ; the natural reproduction is therefore either encouraged or artificially supplied ; the reproduction is expected either by sprouts from the stump (coppice), which method is resorted to, however, only for the production of smaller sizes for fire-wood and tan-bark ; or it is expected from the seed, when proper preparative cuttings in the old timber must be made, and after the young plants have come up, light and air must be gradually given them by removing the old growth ; or, thirdly, after the old growth is removed (clearing) the new crop is sown or planted—generally the latter.
5. Mixed plantations, especially of Conifers, as dominant growth mixed with deciduous trees, have the preference, in planting, for various reasons which it would take too long to discuss here ; experience has shown which are the proper mixtures, the rapidity of height-growth and the varying capacity of shade or light endurance possessed by the different trees being the criterion in their choice for mixture. Close planting is practiced, because the shading of the soil, which prevents evaporation, is of prime importance, and because in a close growth, within limits, the trees grow more rapidly in height, or, at least, straighter, forming clean boles, and are not so apt to spread into branches.
6. But few trees—not more than ten or twelve—are predominantly used in German forestry ; Pine, Spruce, Fir, Beech and Oak, one species of each, being the principal ones. Contrary to statements made by various writers, the bulk of the German forests—probably fully two-thirds of them—consist of Conifers, and the planting mainly concerns itself with Pine and Spruce. Beech groves are usually reproduced by natural seeding or more rarely by planting in bunches ; Oak is introduced by sowing the acorns or by planting one to three-year-old plants on deeply cultivated plots : on better soils larger plants are used, and for tan-bark coppices often the roots alone are planted. For Pine, the rule is to clear small strips, followed by planting with one and two-year-old (not transplanted) seedlings, after cultivation with the plow and subsoil plow or simple preparation of the soil by the hoe. For the Spruce, also, clearing in moderately wide strips, with subsequent planting, is the rule ; but sometimes the reproduction is by natural seeding. For planting Spruce, transplanted plants or else bunches of from three to six plants in a bunch are used—the latter method, however, is losing ground. Larches are planted only as single individuals in intermixture, never in pure growths or

clumps, as when so planted, it has been observed that they fail and are apt to die early. The other woods are generally used in admixtures, but occasionally in pure growths on special sites, as, for instance, the Alder in overflowed swamps and the Birch on safety strips along railroads.

7. In the management of the crop, thinning out is the principal operation. Cultivation with the plow to subdue weeds, etc., is rarely resorted to. This thinning is done first when the crop is eight or ten years old, and is then periodically or annually repeated. Farmers get their fire-wood by these thinnings. The object of the thinning is to give more light to the crowns of the remaining trees, in order to stimulate diameter-growth after they have attained a good height-growth. The thinning must never be so severe that the soil is deprived of shade for any length of time. Sometimes when too many trees have been cut out, or under certain other circumstances, it becomes necessary to put in an undergrowth (underplanting) for the purpose of shading the soil; the cleaning out of undergrowth—shrubbery, not weeds—practiced sometimes in this country, is a useless if not an injurious proceeding.

8. The annual crop is composed of the annual layers of wood which the trees form each year. As these cannot be harvested, an accumulation of many of them, that is to say, trees of proper size fit for use, are cut, while the younger ones remain to grow on. On large forest areas it is desirable to have annually, or at least periodically, the same amount of cut or revenue. In the state forests, therefore, and those of large estates, these amounts are as much as possible equalized from year to year, or at least from period to period. The ideal equalization may be conceived in this wise. Assuming that the most profitable growth is attained in 100 years, as may be the case with a White Pine forest, and we have 1,000 acres under management, then we might cut every year ten acres of 100-year-old wood, or periodically during every period of ten years, 100 acres of such wood. After the forest has been brought under this kind of management (which theoretically would require 100 years, although in practice the process is much modified) we should then have a forest consisting of 100 sections of ten acres each, from one to 100 years old, each differing by one year of age, or if periodically treated, ten sections of 100 acres, each differing by an average age of ten years.

If reproduction from seed is expected, we might cull over even a larger area, making our periods longer. But this culling differs from that practiced in this country. Instead of taking out the best trees first, leaving the inferior or less valuable ones, the culling is done entirely with a view of securing a good new growth, and takes the inferior material first; the best trees are rather left to provide the seed and to gain in proportions, making the most valuable material after they are thus exposed to increased light influence, and they are removed only as the young after-growth requires. The adjustment is practically very much more complicated, since in the same forest area some timbers on certain soils will come to their best production earlier or later than the general period of rotation, assumed at 100 years. The small owner, of course, utilizes his crop when it is at the most profitable age financially, and this varies greatly in different localities; but he looks to its proper reproduction by cutting, so as to secure a vigorous young growth from natural seeding or sprouts, or by replanting after the clearing.

9. Neither the firing of the woods or the browsing of cattle in young growths is considered advantageous to the wood crop and strict regulations in this respect are enforced with good effect.

10. The age at which the crop is utilized differs greatly, according to the use to which it is put, the climate and soil on which it is grown and the kind of trees of which it is composed, and the need and profitableness of the market. The coppice is cut in rotations of ten to thirty years, sometimes even forty years; the longest rotations prevail in Alder and Birch forests in the eastern (colder) provinces. For Beech, which forms the most valuable dominant growth of broad-leaved trees, in the timber forest 90 to 120 years are required, the longer rotation in the mountainous localities and in the eastern (colder) provinces. For Pine and Spruce a rotation of from 60 to 120 years prevails (mostly 80 to 100 years), the longest period for the better soils of the eastern provinces, which are capable of producing good building timber. Alder and Birch in the timber forest will be cut in 40 to 60 year rotation, and Oak, which is rarely found in

pure or extensive growths, but is grown as prominent admixture, is kept over for 140 to 160 years; if "undergrown" in time, sometimes 120 years will produce the desirable sizes and qualities. For tan-bark coppice, it is cut in rotations of ten to fifteen years.

11. Coppice management is practiced in small wood lots and on thin soils, while in protective forests in high, exposed mountain districts a management of culling (or selection) is the rule. The State forests are, as much as possible, managed as timber forest, while small forest owners prefer a combination of timber forest and coppice called "middlewald," which we may render into "standard coppice." In some localities the communities or small owners practice a combination of forest growing and agriculture. After the forest is cut the ground is, for a few years, utilized for agricultural crops, before or even while being replanted to forest; and the economy of this system, with its good results, if properly carried on, will recommend it to our forest growing farmers.

If it is asked, "Is forest growing profitable in Europe?" the answer must be, "it depends;" it depends on what is called profitable and upon the situation. Considering that the European forests are now pretty nearly culled of all their virgin timber and are relegated to the poor soils and waste places, they are probably profitable enough investments.

The German forests, for which pretty reliable data are at hand, yield an annual net dividend of \$57,000,000 from 34,000,000 acres of forest reserve, being considered a three per cent. investment, the soil being valued at \$400,000,000 and the standing wood capital, from which the interest is drawn annually, at \$1,600,000,000. Over a million men find useful and steady occupation during part of the year, at least, and the soil is utilized to its best advantage, with security against the ills of disturbed climatic and hydrologic conditions. Surely, to the nation, forestry is profitable, whatever it may be to the single individual.

HARDWOOD INSPECTION.

Our supply of hardwood for manufacturing purposes, in Ontario, is becoming so evidently limited, that the necessity for caring for the remnants of forest yet existing on our farms, is becoming apparent to all. In fact, both that it is so useful and so profitable to have, on the farm, a stock of timber for occasional use, as well as a supply of fuel, farms do not now readily sell, or when they sell, do not command nearly so good a proportional price, if their acres have all or nearly all been cleared of the last tree. As wood becomes more and more scarce, too, this difference will relatively increase. What we should remember is that, if we have a reserve of fifteen or twenty acres, and keep cattle out, or only let them in when they have good pasture outside, for in that case they will not bite the young trees, we can rely upon this reserve supplying yearly, according to certain well-known examples, nearly twenty or twenty-five cords of wood, or its equivalent in timber, if more suited for that purpose. It cannot be too often stated that a bush, into which cattle are allowed entrance, is apt to become a dry, hard-beaten place, populated by a number of old trees, themselves bearing a dried-out and withered look, soon to show decay at the top, soon to blow down. There are, of course, exceptions; some trees are so well rooted in rich soil that they stand for many years, cattle or none; but the rule is that cattle kill the saplings, hence there can be no reproduction; harden the ground, so that no young trees can take root, far less grow; rub the trunks of the older trees until the bark is in no state to assist in the progress of the tree, and a sort of invisible girdling

takes place. The bark is there, but there is a worn ring cattle-height around the tree, and though death does not follow so inevitably as when the axe has girdled the tree, yet a slow deprival of life ensues, and in a few years, if cattle be many, the whole plantation is of no more use for cattle, or for anything, save to be cut down and sold for what it will fetch. What is wanted in a piece of forest kept for forest purposes is, that the original leaf-carpet be still spread over the ground, that the young trees, which will by their seeds readily take root under this carpet, be allowed to live, and that the whole wood lot be a scene of reproduction, where as soon as one mature tree be cut down, another is ready to supply its place, and another still younger is following fast in the footsteps of the second. Such a wood lot will give the owner yearly plenty of wood; it will hold the moisture and send it to the fields when needed; it will aid in attracting rain when rain is wanted; and it will continue thus, for forests or forest patches are perpetual when allowed to be reproductive. A dried up piece of former forest, now half dead trees, with cattle beaten ground, all its saplings gone, will do none of these.

Whoever cares for his hardwood lot will have something to sell to the manufacturers, and it is important to know how to cut—to what size—and what imperfections are allowable in sale. For this purpose I have copied the following excellent list of directions from the *Canadian Lumberman*, which will be found of great use in such cases:—

One of the subjects but seldom touched upon heretofore in the columns of *The Lumberman* is that of inspection of hardwoods. In order to cultivate the desire to inaugurate a uniform system, which, whatever else it might do, would be a step to making the culling of our hardwood somewhat similar by each culler, we have prepared the following, which we think will be found to be in practice about what is done by most of our hardwood inspectors. The rules as given have been followed for years by many of our readers who have given particular attention to the timber growing in different parts of the country, and we fancy they are about as near right as can be applied in actual culling.

It would be a matter of considerable interest if some of the hardwood inspectors would give their views on the subject. Should a discussion be brought about and the rules herewith condemned as being too rigid, we shall be pleased to see the subject thoroughly gone into by practical cullers.

Ash.—The standard lengths are 12, 14 and 16 ft. The standard thicknesses are 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, 4 and 5 inches. Waggon tongues—to be cut from the toughest timber and free from all imperfections, particularly that of cross grain. Length 12 ft. 6 in.; size 2x4 at one end by 4x4 at other, and $2\frac{1}{2}$ x $4\frac{1}{2}$ at one end and $4\frac{1}{2}$ square, splits not allowable. Firsts—Must be not less than 12 ft. long nor under 8 in. in width and at such width and length be clear. At 12 in. wide a standard knot will be admitted and no other defect. As width and length increase defects are allowable in proportion, but in no case shall defects be such as to prevent the piece from being used as a whole in the best kinds of work. Seconds—Width not less than 7 in. nor under 10 ft., and at such must be clear. From 8 to 9 in. one standard knot allowed. As dimensions become greater imperfections are allowed in proportion, but five-sixths of the piece, as a whole, must be suitable for good work. Heart shake, rot, dote, wormholes and bad manufacture are excluded from Nos. 1 and 2. All lumber to be cut $\frac{1}{8}$ in. over the required thickness and well manufactured. In black ash particular attention is directed to the annular rings, as in inferior qualities of this wood they are often detached.

Basswood.—Standard lengths are 12, 14 and 16 ft. The usual thicknesses are 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ inches. Firsts—Must not be less than 7 in. and free from all defects. Seconds—Must not be less than 5 in.; at this width, and up to 6 in. must be clear. As width increases defects are allowable in proportion, but no piece however wide having

black sap shall be taken in this grade. Sap must be bright and in good condition. Pieces having defects so numerous or of such nature as to render five-sixths, as a whole, unsuitable for first-class work must be excluded. All lumber to be well manufactured, plump thickness and free from stain.

Beech, Birch, Maple.—Standard lengths are 12, 14 and 16 feet. Standard thickness 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, 4 and 5 inches. Newels—Must be free from heart and cut so as to square 5, 6, 7, 8 and 9 inches. Length to be four feet or the multiples thereof. Balusters—Must be cut exactly square 2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3, 4 inches, and on length from 28 to 32 inches, to be entirely free from all defects. Firsts—To be not less than 8 in. wide and perfectly clear to 12 inches. At 13 in. one standard knot allowable or one and one-fourth inch of sap on one edge and side, with a perfect face. Defects in proportion to width and length, but in no case shall the defects prevent the piece from being used as a whole. Sap must be bright. All pieces to be evenly sawed, square butted and square edged, plump thickness when seasoned and free from taper. Seconds—Not less than 7 in. wide and clear. At 8 in. wide one small sound knot may be allowed, but no other defect. As width increases defects in proportion are admissible but not to decrease the piece below the above standard nor render five-sixths of it continuous, unavailable for good work. A short split, parallel to the edges, and not exceeding one-twelfth of the length on one end is a defect, but admissible. When sap, knots, splits and bad manufacture combine to render the waste greater than one-sixth of the piece such a piece must be rejected. Sap must be bright, knots small and sound; and the lumber entirely free from heart.

Butternut, Walnut, Chestnut.—Standard lengths are 12, 14 and 16 ft. Standard thickness 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, 4 and 5 inches. Balusters and newels same as in birches. Counter tops are from 12 to 18 feet long, and from 20 inches and upwards in width, strictly clear. Firsts—Must not be less than 8 inches in width free and clear from all defects. At 12 in. wide may have one end one-half inch of sap on one side, face clear. No defects are allowable that will decrease the piece below the standard waste to be allowed in this quality. Seconds—Not less than 7 in. at which width it must be clear. At 9 in. wide two defects may be allowed and as width increases defects in proportion. Waste not to exceed one-sixth of the piece.

Cherry.—Standard lengths are 12, 14 and 16 ft. Standard thicknesses are 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, 4 and 5 inches. Firsts—Not to be under 8 in. wide clear and free from all imperfections. According as the width increases defects are in proportion, but in no case must there be any loss in the piece. Sap when allowed must be bright. Seconds—Not less than 7 in. and must be free of all defects. At 8 in. one defect will be allowed; at 10 in. wide two defects and so on as the width increases; but in no case must the loss exceed one-sixth of the piece. All pieces under 12 ft. long and 7 in. wide must be entirely free from knots, sap, gum specks and splits. Gum specks are excluded from firsts.

Elm, Soft.—Standard lengths are 12 14 and 16 ft. Standard thicknesses are 1 in. and 2 in. Firsts—Not to be less than 10 in. wide at which and up to 13 in. must be perfectly clear and free of all defects. Whatever defects are allowed in wide pieces must not cause any waste, must be cut plump thickness and well manufactured. Seconds—Not to be less than 8 in. wide, and at such must be clear. At 10 in. wide one defect will be allowed. Defects are not allowed in such numbers nor of such kinds as will cause any greater loss than one-sixth of the piece.

Rock Elm.—Firsts—Shall be free from rot, decayed knots and open annular rings; must be cut plump thickness and well manufactured. Each piece as a whole must be free from all imperfections that would prevent it from being used in the best kind of work. Heart pieces not admitted. Seconds—Include all lumber which can be used without a greater waste than one quarter. The three-quarters must be three continuous quarters.

Hickory.—Firsts—Shall be not less than 7 in. wide and free of all defects. Seconds—To be not less than 6 in. wide, and may have a few sound knots. Not less than two-thirds of the piece must be available for good work.

Oak.—Firsts—Must be 8 in. and over in width, clear and free of all defects. All pieces to be evenly sawn, square butted, and square edged. What knots are admitted to be small and sound and not to exceed in size the standard, and so few as not to cause waste to the best kind of work. Pieces having worm holes are absolutely excluded. Seconds—Must be 7 in. wide and clear. From 8 to 10 in. will allow 2 to 5 knots, small sound knots, of standard dimension, or a little bright sap. Two-thirds of each piece must be available for ordinary work. The standard lengths of oak are 12, 14 and 16 ft., thicknesses are 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, 4, 5 and 6 inches.

Quartered Lumber.—To find ready sale this lumber must be of good width and plump thickness when dry, not to be under 5 in. in width.

FOREST AND RAINFALL.

We are now obtaining some actual data on this question, which is perpetually exciting discussion, the governments of Germany and India having for many years maintained a large number of experimental forest stations, the results of the observations at which are summarized in the valuable article from Mr. Fernow, which follows this. It is necessary that reliable information be circulated, for through the press, every year, numbers of statements are made, generally by anonymous parties, calculated to do great injury. At a late meeting on forestry in the States, for instance, the astonishing sentiment was expressed, and was immediately circulated broadcast through the papers, that in the opinion of the speaker, it would be well if every tree on the Rocky Mountains were cut down, so as to allow free course to the rainfall. What all who have studied the question know to be the case, is, that wherever mountains have been divested of their forests, great evils have followed, as the moisture is no longer held back by the woods, and devastating floods carry all before them. Whole villages have been thus overwhelmed, and great valleys of fertile land rendered worthless by the mass of earth and stones deposited on them.

What is to be noticed is this. There are too many who care nothing for the future interests of any country so that they can obtain a present pecuniary return. Guided by this, all through America, valuable forests have been destroyed which might well have been preserved, the clearing of which has given little or no benefit to agriculture, and where this clearing has been performed on mountain sides, an injury is perpetuated which needs centuries of labor to efface. Both in France and Italy governments have been for years spending vast sums in endeavouring, with slow and painful toil, to replant slopes which have been ignorantly cleared, the earth then washing away, and the rocky and channelled surface offering now great difficulties to replanting. With a little care, or often with no care whatever, but to be left alone, these slopes would have remained in forest, and all the loss suffered by clearing, and the expense of replanting, have been alike avoided. But in spite of these warnings, year after year great extents of the Adirondacks lose their wood, the axe is most wastefully busy in the great redwood forests of the Pacific slope, and now statements are made that it will do no harm. Whence do these statements originally

arise? Surely, I should think, from some of that rich and from their actions unscrupulous body of men who have so wastefully destroyed most of the forests of the States, and who now see in the forestry agitation a possible danger of legislation which may hinder them destroying the rest.

What we know of the direct influence of forests on the rainfall is this. The great mass of vapour which forms rain rises in air from the equator and is carried to the poles, the winds which bore it coming back largely divested of their moisture. These winds going to and returning from the poles are the only two chief winds of the world, the others being merely side currents and modifications of these. Of these two, going and returning, one is nearly always in air strata above the other; yet they have occasional meetings, and it is these meetings, when the differently heated bodies of air join, which occasion precipitation, and cause the showers to fall on the earth. From this cause alone rain would be distributed over all the earth, but there are local causes which, it seems, have much to do therewith. A tall ridge of mountains, intercepting a warm moisture-charged cloud in its passage, raises it to a colder stratum above, and rain necessarily ensues, for as soon as the body of air holding much moisture is suddenly cooled, it is rendered incapable of holding as much, and the balance drops down in rain. The local influence of a body of water—a lake or river—sending up much evaporated moisture, is also strong, and you may see shower after shower follow the course of a river, while the higher land stays dry. But above all local causes of influence is that of forests in their natural state, for then the deep bed of decayed leaves and roots beneath them is a reservoir of cool moisture, and it is their nature and part of their being, when in leaf, to throw off vast quantities of moisture, which arise at once to the clouds, and being cooler than they, tend powerfully to produce rain in spring and summer, when rain is most wanted. On the other hand, a dry arid plain, acting in the precisely opposite direction, absolutely prevents rain. Why?—because instead of cool moisture charged air, tending to cause precipitation and rain when it unites with the clouds, it sends up vapour in a high state of expansion, heated, containing but little water for its bulk, and therefore instead of condensing the clouds it encounters, it further expands them, and hinders, instead of producing rain. Thus it is said of the desert:

“Where nought can grow, because there is no rain,
And rain is not, because that nought does grow.”

So over the vast plain of the Deccan, largely deforested by the natives, the rain clouds have for years beyond memory passed to the Himalayas, leaving the plain ever dry and thirsty behind. Part of Indian forestry is the planting of forest clumps on this plain, knowing thereby that the rainfall will return in its season as soon as the action of the groves is sufficiently marked.

In an examination of two townships in Ontario last year, over two hundred farmers gave their opinion on this subject, and all, who had given any attention to the matter for any length of time, agree that when there were more woods, fertilizing summer showers were far more frequent, and that since there have been less trees, instead of these beneficial showers the country is occasionally visited with much heavier torrents of rain than before, these doing, said several, more harm than good, as they seem to wash everything away.

What is certain of woods is that earth and air send them all the materials of their growth, and that these are carried to them by the vehicle of water from the earth, and accompanied by more or less vapour from the air, after which the water passes away in vapourized form from the leaves. The quantity thus transpired from the forest in leaf repeated experiments have shown to be immense. We know that the vapour of water being the lightest of vapours, it must rise, and that when it rises from woods its tendency, as explained, is towards precipitation and rain. Every dweller in open and partially cleared countries has repeatedly seen the rain clouds pass large cleared spaces, and apparently break into rain above the wooded section. It follows then that the presence of woods, in summer, causes a current of moisture, rising through the leaves, ascending into the air, falling in rain, and after a while again ascending. These are the great local causes of the distribution of fertilizing moisture.

The article I quote, which I trust my readers will carefully peruse, gives us the benefit of the great forest systems of Germany and India, and of the observations collected at their numerous stations for many years. It will be seen that great care is taken not to overstate effects, and that we have here a collection of facts on which we can rely. It will be also observed that the data given do not materially differ in the tropics from those in the temperate zone. The admirable system under which young men are now being trained for foresters in the Indian service at Cooper's Hill, England, is elsewhere described. Germany has long had similar schools—in fact, the Indian plan is based on the German one.

DO FORESTS INFLUENCE RAINFALL?

If I could find the place on the earth of which it was first and emphatically said "It never rains but it pours," I am convinced that it would be a plain largely deficient in forest-growth. For, if there be an influence upon moisture conditions of the atmosphere exerted by forest areas—and such areas must not only be of sufficient size, but also densely enough covered to exert their proper influence upon temperature and moisture within and without—it consists, I believe, in a more equal distribution of precipitation with reference to space and time.

In the end, what does it matter whether it is by increased precipitation that the forest benefits the field, or whether the same physiological effect is produced by increased relative humidity in other ways, or by raising the water level and increasing and advantageously disposing of the available water supplies through favorable ground-water conditions or surface channels?

As this question of forest influences is one which, to a great extent, underlies the demand for national interest in the forestry problem, it may be of advantage to review briefly the methods which have been employed to solve the question. Space will not here allow a critical consideration of the value of each method, which may be given at some future time.

As is natural, the first suggestion that a relation between climate and forest-areas exists, came from general observation. History testifies that districts once surrounded by verdant groves, with fertile soil and favorable climate, have become inhospitable and desert wastes, with treeless mountain-sides, and the conclusion follows that there is a connection between the forests on one hand and fertility and genial climate on the other. This method of proving the proposition, which has been the most popular, and is still largely in vogue, may be called the historico-statistical. Among the eminent men who have used this method may be mentioned Du Monceau, Reaumur, Buffon, Humboldt, Arndt. It is not to be entirely discarded now, but its results must be adopted with caution, for not only are the reports of the facts in many cases dubious, but the inferences are not always reasonable.

About the middle of this century, with the development of physical, and especially meteorological science, a second method was applied. This method attempted, upon a theoretical basis, to discuss and reason out the assumed relation by employing the accumulated physical and meteorological data, which, scanty at first, has lately been considerably increased. Among the prominent meteorologists to employ this method first was Becquerel. The results of this method have brought us considerably forward in the determination of the direction in which an influence would be possible, or even probable; and while it has not been able to either prove or disprove satisfactorily the existence of this influence nor advanced our knowledge of its degree and quality, it cleared the way for a more scientific consideration and investigation of the subject.

The next step and method of demonstration employed was the mathematical one, using numerical data which had either accumulated independently of the question or were specially provided for the purpose. We have here to distinguish two methods, a wholesale and a retail one, if I may so express it, or, more scientifically speaking, the one using large averages and comparing data from extensive areas, though not specially provided for this end; the other comparing data obtained for the purpose in limited localities by direct detail measurements within and without forest areas. The latter method, which I call the retail one, is the one now largely adopted by German investigators.

The first attempt to obtain, for the settlement of this question, a series of exact, methodical observations, dates back to the year 1864, when Dr. Ebermayer, Professor at the University of Munich, constructed the necessary apparatus, and with the aid of the Bavarian Government and Forest Administration established in 1866 the first three double stations, where a set of meteorological instruments were observed within a forest area, and another set simultaneously in a field. In the following year the number of double stations was increased to six. In 1869 Switzerland followed with three stations; in 1870 Italy established a station, and in 1874 to 1877 Prussia entered upon this field of work, having now sixteen stations in connection with the forest experiment stations; and to-day quite a number of double stations are collecting data in all parts of the country.

The points of observation at the Prussian stations are chosen 200 metres (about 664.5 feet) distant from the edge of the forest within and without. An enormous amount of material has accumulated, but as yet has not been summarized or turned to account. It is difficult to see how anything else can be demonstrated by it than what is already known—namely, that the meteorological conditions within the forest are different from those prevailing without. Whether the forest conditions are communicated to the open field, and to what degree, if at all, can certainly not be proved by the data obtained. By establishing points of observation in the field at varying distances, it might have been possible to demonstrate the presence or absence of climatic interaction between forest and field.

In the wholesale methods, which use data obtained over large areas independently of the special objects of this investigation, we may again discern two ways of handling them: the one comparing the data found during various periods at the same stations and bringing them in relation with forest conditions existing at the various periods; the other comparing data obtained simultaneously from stations situated differently as regards other climatic influences. The first method has been employed by Mr. Gannet and Mr. Harrington. Mr. Gannet endeavors to establish by a combination of data that neither for Ohio, which has been largely cleared, nor for New England, which is said to have largely increased its forest area, nor for the Prairie States, which contain more timber in recent times than formerly, can a noticeable difference in rainfall be demonstrated. In fact, however, he only proves that his method leads to no certain result for lack of adequate data to work upon. Mr. Harrington's method fails to be conclusive for the same reason—lack of proper data. He arrives at the opposite result from that of Mr. Gannet for the same region by comparing the position of isohyetal lines constructed for two different periods about thirty years apart.

The second class of wholesale methods, which compares data simultaneously obtained from stations differently situated as regards forest conditions, has been lately employed

by the eminent Russian climatologist, A. Woeikoff. He chooses an area in Northern India, which is partly a treeless region and partly densely wooded, and is otherwise uniformly situated with reference to other climatic influences. He concludes from his data that, at least for sub-tropic regions, a forest cover has the effect of reducing temperature extremes and increasing precipitation.

Woeikoff further investigates whether the influence of the forest upon the climate of surrounding areas may also be proved for latitudes of thirty-eight to fifty-two degrees north—all the West European Continent—and he proceeds as follows:

Taking the temperature of July as that of the warmest month, and assuming that on the whole, the temperature at the Atlantic coast is lower and rises toward the interior of the continent, he compares the temperature of a number of places situated near the fiftieth degree, the observations being all taken outside of the forest. To bring them upon a uniform basis for comparison, he assumes an increase of temperature of 0.5 degrees, centigrade, for each degree of latitude towards the south, and a decrease of 0.7 degrees for every hundred metres of altitude. By an easy calculation he then obtains the mean July temperatures for every station in this line, reduced to exactly fifty degrees, north latitude, and 200 metres of altitude.

The result is that in this series a rapid rise of temperature appears from the Main River, eastward, then a considerable reduction in the eastern and western Bohemian stations, where large forest areas prevail, while in the Bohemian basin the temperature is higher, as it is also in Silesia, and again much lower in the well-wooded Carpathian Mountains of Hungary. The apparent influence of these large wooded areas is still noticeable in east Galicia as far as Kiew, where the neighborhood of forest and morasses works in the same direction, while in the Steppes the highest temperature is reached.

In the same manner a series of stations lying on or near the forty-sixth degree are treated, reducing their July temperatures to the theoretical temperatures for the forty-sixth degree and 200 metres of altitude; and another series of stations is worked out for the forty-fourth degree in Croatia, Bosnia, Herzegovina, Dalmatia, and here the heavily wooded Bosnia is found from twenty-five to forty-five degrees cooler.

The results of these comparisons lead the author to conclude that in the western part of the continent large forest areas influence the temperature of neighboring localities, and interrupt the normal increase of temperature from the Atlantic Ocean into the interior of the continent to such an extent that even regions far in the interior have a cooler summer than those nearer the sea.

He concludes further, not only that there exists a climatic influence of the forest, but that it exerts itself over considerable distances according to the size, kind and position of the forest areas; that, therefore, forest-planting or deforestation offers a means of changing a climate considerably.

Another modification of this method has been employed by H. E. Blanford, and by Dr. Brandis, late Forest Inspector-General of British India, by comparing the records over a confined area (61,000 square miles and 600,000 acres, respectively) during a decade of forest destruction and a decade of forest protection under government regulations. In both cases a progressive increase of rainfall is observed in the second period, until the mean increase within ten years has been twenty per cent. and twelve and one-half per cent., respectively, for the two areas thus reforested.

The latest interesting, instructive and quite novel application of the wholesale method is that employed by Dr. F. J. Studnicka, Professor of Mathematics at the University of Prague. It consists in comparing the rain records of stations differently situated as regards forest conditions, after the records have been reduced to a theoretical quantity which corresponds to the altitude of the station. To understand the significance of these observations, the reader should refer to a map of Bohemia, and note its peculiar geographical position, being a basin shut in on all sides by high mountain ranges, inclosing an area of about 20,000 square miles.

This basin has been covered with a net of over 700 rain-gauge stations, for the purpose of obtaining accurate data of the quantity and distribution of precipitation over the kingdom. Uniform ombrometers (rain gauges) were used and very carefully placed. As at present organized, there is one station for every thirty square miles. No other

country, I believe, can boast of such a service. Although the time of observation at most stations has been short, and the averages would have been more accurately represented by an extension of observations for ten to twelve years, yet the last four years of observation, for which all stations furnish data, according to the author, represent two extreme and two average years, and are therefore quite useful.

The very large mass of material permitted a sifting out of doubtful observations without impairing the number available for the construction of a rain-map of Bohemia, showing by isohyetal lines seven rain belts or zones, the lowest belt showing an annual rainfall of less than twenty inches, the second a rainfall of less than twenty-four inches, the third of twenty-eight inches, and so on.

Sufficient material was on hand from which to calculate the influence of altitude on the increase of precipitation, although for altitudes above 1,600 feet the material is not considered reliable. Yet the general law is well shown that with the altitude the quantities of precipitation increase in a retarded progression. This progression is calculated by forming zones for every hundred metres of altitude, grouping the stations in each, calculating the mean elevation and also the mean precipitation as observed for each; then by dividing the difference of precipitation in the neighboring two zones by the difference of altitude, the amount of precipitation which corresponds to each one metre of elevation within that zone is found. With this figure the average amount of rainfall which, theoretically, belongs to each station, according to its absolute elevation, can be approximated by adding to or subtracting from the mean precipitations of the zone the proper correction for the number of metres between the actual altitude of the station and the mean altitude of the zone.

And now comes the application of this method to the question in hand. The author argues that if the actually observed differs considerably from the theoretically calculated rainfall, this is an indication that special interests are at work. He finds now that of the 186 stations which he subjects to scrutiny (these offering the longest and most trustworthy observation), forty-eight show a considerable excess of the observed over the theoretically expected rainfall, and he finds also that these stations are situated in the most densely wooded portions of the kingdom. The increased rainfall on the forty-eight stations is so considerable, that enough of it may be credited to other local causes, as for instance, to the height and form of a mountain range on one side or the other, and still leave a large balance to be accounted for. Besides, the greater amounts of rainfall at these stations have been used in calculating the averages for the altitude zones, magnifying, therefore, these averages, so that the difference between the calculated rainfall and the actually observed rainfall appears smaller than it really is.

Expressed in percentages of the amount of precipitation a large increase is shown for several localities—as much as fifty-nine per cent.—and it would seem that so great an increase would not lose its significance as bearing upon the main proposition, even after every reduction for other influences is made.

Especially important appears the comparison between two stations near the rain minimum, for the influence of the forest is here plainly shown.

BRITISH PARLIAMENTARY INQUIRIES ON FORESTRY.

For the past five or six years the subject of forestry has, to a considerable extent, engaged the attention of the British Parliament, and committees have at great length examined into different questions connected therewith, such as the possibility and desirability of re-foresting a large part of Ireland, now waste and comparatively useless land; the advisability of establishing schools of forestry at different parts of the United Kingdom, in addition to that at Cooper's Hill, described elsewhere, and other matters in connection with the various crown forests of Britain. The results of these investigations, which

were attended by witnesses from all parts of the country, comprising many of the gentlemen who had chiefly undertaken and managed the great work of forestry being carried on in India, many leading gentlemen possessing large wooded parks and forests in Britain, and many of the foresters engaged under them, fill a number of ponderous blue books, and could not, of course, be quoted at length in this report. But here and there, in the evidence given, were points of great interest to Canadian readers, which are quoted as they occur, with the name of the witness stating them. It seemed to be the general opinion of those examined, that while schools of forestry were no doubt excellent if practicable, yet those who stood most in need of the lessons taught at such, namely : the foresters employed by the owners of British forests, would be unable to meet the expense of passing terms thereat of sufficient length to give the theoretical knowledge, of which such pupils would be most in need, nor would their employers generally be likely to furnish them with the means. Trained gardeners, it was remarked, were obtained by an apprenticeship to gardeners, and trained foresters, it was suggested, might be obtained likewise, by an apprenticeship to foresters of known ability. The school at Cooper's Hill, above referred to, is part of the system for training young men for the Indian forestry service, though all are admitted who wish to go through the curriculum adopted there, and are willing to pay the fees demanded. The principal (one of the witnesses) expressed the opinion, that if additional accommodation was provided by government, and additional teachers engaged, the institution could undertake the tuition of a much larger number of the class in question than are now instructed there. The difficulty existing, however, which all admitted, was that while the vicinity of a forest where the practical working of forestry could be obtained was absolutely necessary, the Windsor forest practice was entirely different from that of Scotland, and that again from what was necessary in Ireland, so that three schools at least would be desirable, while it was doubtful unless tuition was to a great extent free, if they would find a number of pupils at all commensurate with the importance of the work desired to be done, and the sum necessary to establish the institutions. At present, therefore, the British student of forestry is limited to the Cooper's Hill accommodation. It should be remarked that in Scotland, however, a board periodically sits to examine pupils who wish forestry certificates, (generally individuals who have been employed in some of the Scottish forests), who consider such certificate would give them an improved *status* and probably enable them to secure a better situation than they otherwise could obtain. There is no fee charged for the certificate. The examiners are generally gentlemen who have had experience in forestry abroad, or are foresters in charge of some of the large northern woods.

What will be found of most interest to Canadian readers are the statements made concerning the lumber trade with America, made by English merchants, whose firms own and operate saw-mills on this side the Atlantic, and the many valuable experiences narrated concerning the management of forests, the value of timber, and other objects of great importance to all interested in forestry.

MR. PEDDER, INDIA FOREST DEPARTMENT.

Now improved forestry in India has produced several beneficial results, has it not, for instance, in regard to a more permanent water supply ; has that not been found to be

so?—Yes, the destruction of forests was undoubtedly seriously affecting the water supply in many parts of the country, and seriously affecting the climate.

And, indirectly, by affecting the water supply, did not the great denudation of the surface lead indirectly to the famines, which have decimated the country to such a large extent; I do not say it was the sole cause, but was not it a very potent cause?—Yes; of course any cause which makes the rainfall either more scanty or more uncertain, has a tendency to lead to famine. It would be difficult to say to what extent the denudation of the forest lands has actually caused famine, because probably there were famines when the country was all covered by forests which were worse than any we have had of late years; but then those famines were due to other causes.

And is it not also well recognized that the growth of forests leads to the storage of water and its gradually being distributed in streamlets and rivulets to the streams which it ultimately supplies?—I believe that is an unquestionable fact and is the foundation of all forestry.

Do you know of any other material effects which have been produced by denudation on the one hand of your forests of India, and by the restoration of them in the last 39 years in the other?—There is a district called Ratnagiri, south of Bombay; it is a rice district which lies between the sea and the Western Ghats—which used to be considered to be the most productive of the rice lands of the West of India at that time—I am speaking of 50 years ago—and I know from the reports which I have read of the officers who were employed to make the original trigonometrical survey, that that country was covered by dense forests. The diaries of those officers show that in some cases they had to cut a base line at the rate of half-a-mile a day for miles through dense forest—whereas now the same district has been almost entirely denuded up to the crests of the hills; the hills are now almost a bare sheet of rock; and people have complained and complained bitterly of the decreasing yield of the rice land below, which has been attributed, and I believe truly, to the destruction of the forests, which operates of course to prevent the water from being stored upon the hill sides; it runs away in violent floods instead of flowing gently over the country.

DR. CLEGHORN, M.D., F.R.S.E., CONSERVATOR OF THE MADRAS FORESTS.

With regard to Canada, are you aware that the great supplies that we draw from in Canada are being very seriously diminished?—I have not myself seen it, but there can be no doubt of the fact from what we read.

Perhaps you saw the report recently procured through the kindness of the Marquis of Lansdowne, wherein it is shown that the Province of Prince Edward's Island, which was once very richly wooded, is now totally denuded of timber; the Lieutenant-Governor reports that there is no longer any timber to export there, that it has all gone down under the clearances by lumbermen, and the general traffic in timber?—I believe that is so.

Do you think this country can depend in the future, as she has done in the past, upon her supplies from abroad with the same certainty as was formerly the case?—There is no doubt that the supplies are rapidly diminishing in many countries; there can be no doubt whatever of that.

COLONEL PEARSON, NANCY FOREST SCHOOL.

I want to ask you a question about matured forests; do not some authorities hold that it is better to get frequent crops off your land?—The German theory which is now being taught, especially at the Saxon School, at Tharandt, is that the most profitable time to cut a tree down is when it is two-thirds grown. Formerly matured timber was much more wanted than it is now; iron and steel now supply the wants for which large timber was formerly wanted. And when a forest is about two-thirds grown there is the greatest volume of timber on the ground, there is no doubt about that; because, supposing you have 1,000 trees growing upon a certain space of ground, when they are 20 years old, some of them—the weaker ones begin to disappear, and at 40 years you will only have on that space 500, and at 60 years more will disappear, until at last you will have only 50 or 60

mature trees. There is a certain moment when the trees in proportion to their size stand thickest, and that is when they are two-thirds grown; therefore, it is more profitable to cut the crop down then and to replant it, because you have to count compound interest on the value of the crop as it stands upon the ground from the moment of its removal up to the time when it would have arrived at maturity; that will repay, and more than repay, the cost of replanting the ground.

Two crops of trees, when 40 years old, are better than one crop of trees of 80 years old?—Yes; or what I would say is, that two trees 70 years old are better than one tree of 120 years old.

MR. THISELTON DYER, ASSISTANT DIRECTOR, KEW, ENG.

You were going to mention to the Committee some facts connected with the Colonies; would you now kindly do so?—I was going to explain how the sudden demand for assistance in forest matters in the Colonies has arisen. It is very much in this way. When a colony, for example, in the condition of Honduras, which has been very little opened up, is first occupied by planters, a great part of the surface is naturally covered with forest. For a very long time that forest can be drawn upon; in fact, it may be used up, and even destroyed, without attracting any great attention; but there comes a point, when the denudation of the forest reaches the highlands, and especially in tropical countries, when the banks of rivers are denuded, that the water supply begins to fail, the rivers begin to dry up, the hot winds are let into the lowlands from denuding the ridges, and a variety of changes in the physical conditions begin to force themselves upon the attention of the residents. Then for the first time it dawns upon them that the destruction of the forest has either gone too far, or is within measurable reach of doing so; the Colonial Government takes the matter up, and applies to the Home Government for assistance in getting the thing investigated. When a colony has reached that condition it is ripe for the constitution of a Forest Department, because you must maintain some forest protection over the sources of rivers. You must keep the ridges of mountain ranges clothed, or the hot winds will pass over them and dry everything up in the valleys below. In the Cape, for example, the amount of forest which exists has been reduced to very small limits indeed. A French count, the Comte Vasselôt de Regné, has gone out, at Colonel Pearson's suggestion, as forest officer, and he gives a most deplorable account of the state of things. To us, one result which he mentions is almost incredible. You would think that a country like the Cape with large supplies of timber would be able to supply itself; but the forest officer states that the Cape imports something like £80,000 worth annually of soft pine wood from the north, I suppose either from Scandinavia or from America. In Natal there is a considerable import of pine wood and so there is into Jamaica, and indeed even in India it is suggested that notwithstanding the activity of the Forest Department pine sleepers for railways have been imported from Europe. That shows that the drain upon the soft woods of the northern hemisphere is at the present moment something prodigious. I apprehend that cannot last, that there must be a general decrease in the supply of the soft woods, and I think that it is very likely that it would be to the advantage of a country like England which is capable of growing wood, but where at present the marketable value of wood is, I am afraid, very small.

COLONEL PEARSON, NANCY.

Is it allowable on the part of the owners of forests in France, to convert wood into arable land?—Not before they get the permission of the forest officer of the district; before they can make a *défrichement* they must get the permission of the forest officer. There are some conditions, without which a forest cannot be cut; but otherwise they obtain permission in the regular way.

The system of felling that they teach in the German and French forests is simply a gradual thinning out to let the sunlight touch the ground, when reproduction will take place at once.

Do you think that beech, elm, and that class of timber, say beech, could be planted after oak and larch after beech, or *vice versa*, without the danger of encouraging disease

in the timber; or do you think that all timber should be regrown upon the same soil?—If you planted oak and beech together there would be no trouble; the great trouble is that very few soils will bear one species of timber alone.

If you plant larch after another crop of larch, that is likely to encourage disease in the larch. Do you think that if you planted beech after beech, that would encourage disease in the beech?—No; because it would come with a totally different class of tree. It is for that reason if you plant beech and oak together, as the whole of the trees are not drawing upon the same elements of the soil, that they become stronger.

So that in planting forests you have to be careful not to plant the same class of trees that had grown there before?—Certainly not; and also you should mix the trees. You should select what trees you think would be suited of two or three sorts and plant them mixed together. Ash, beech and larch would often grow well together in certain localities, and beech and larch always will. In some cases you may introduce oak, because I know Mr. Banks' forests have some exceeding fine larch trees mixed with oak.

M. Boppe suggests that sheep might be advantageously kept out for the first 40 years and the last 20 years, but that they might be admitted during the intermediate period of 60 years, and that the pasturage in that case would be very good; did he not intend to imply that, in his judgment, the Scotch foresters scarcely adopted what he considered to be the best rule with regard to the admission of sheep into forest lands?—Certainly; it is a very important thing. If you allow that the life of a forest is 120 years, you would have better grazing during 60 years of it if you kept them out during the first 40 years and the last 20 years; it would rest the land.

REV. J. C. BROWN, L.L.D, SOUTH AFRICA FOREST SUPERINTENDENT.

Is it the fact that in Poland, Russia, Austria, Finland, Sweden, France, and everywhere in Germany, there have been established by the Government schools of forest science or classes in connection with existing universities?—That is generally the case, and many of them I have visited.

That has to some extent arisen, I think I gather, from the fact that from the situation of those countries the supply of timber for the purposes of fuel, and also for other purposes, has not been so accessible as it has been to us in Great Britain?—It is very largely so; but it is also the case in the United States of America, in Canada, and in many of our colonies, that the country is being ruined by the destruction of forests, owing to the effect produced upon the humidity of the climate. It is an open question—I have my opinion upon it—whether or no forests increase the quantity of rainfall; but whether they increase it or no they certainly do affect the distribution of rainfall, both in time and space. The distribution of the forests may have arisen from the distribution of the rainfall; but the forests once established, there is a very much more equable distribution of the rain in time, and of the rain in space. Besides this, great destruction has been wrought, and is still being wrought, by inundations; and it has now been proved, beyond all question, by expensive experiments, and not only by experiments, but by extensive operations with results which have fully justified the undertaking, that there is no more efficient way of preventing inundations than planting the basin of reception with trees; and it is the most thorough way of doing so.

MR. W. SCHLICH, PH.D., INSPECTOR GENERAL OF FORESTS, INDIA.

Out of the grand total of 6,000,000 loads of timber, Canada supplies us with 1,500,000; and I believe you have stated that gloomy reports have been received of the extensive destruction of forests in that country, and that, of course, also we cannot reckon safely upon receiving such large supplies in the future as we have received in the past?—As far as I can gather from the means at my disposal, I am inclined to think that the falling off in the supply from Canada, will be much quicker than that from Russia and Norway.

I understand, from your answer to Dr. Farquharson, that you are of opinion that the price of wood is likely to go up in future?—I meant to speak more correctly, that the supply from outside was likely to fall off, and that therefore home-grown woods were more likely to find a ready market at home.

But in the timber-growing countries from which we import the wood, do you suppose more timber is cut down annually than is grown?—It is very difficult to show a thing like that by figures, because the reports are of a very general character, and one can only form a very general opinion; but I think, upon the whole, that the supply is likely to fall off. I believe the countries which at present principally send their timber to England are overworking their forests, and that the present supply cannot last.

And the price of timber will go up, seeing that the area of forests easily accessible to the English markets is diminishing?—Yes, that is to say, the area of timber-producing forests is.

MR. WILLIAM BARRON, DERBY.

Have you had considerable practical experience of the planting and management of woods?—I fancy I have had rather more than most men. I have had 50 years at it.

Can you give some idea as to the scientific knowledge valuable to a forester?—The forester ought to know something of arboricultural botany. Take the pine tribe, there is a certain class of the pine tribe which is only two-leaved; they only throw their leaves off the third year; they have only two years' leaves upon them, and if you allow those two years to pass over you cannot make them shoot; but I have found out that in the centre of any two, three, or five-leaved pines there is a dormant bud, and by stopping the shoot you can manage to make as many leaves come out as you like, and that is very desirable, because the leaf of the plant is the lung of the plant, and the amount of sap elaborated is in exact proportion to the amount of the square surface of foliage upon a plant.

Do you mean that you can turn the two-leaved pines into the three-leaved pines by stopping the shoot?—No; but you will understand me that you never have more than two years' growth upon a two-leaved pine; the third year it throws the leaf off, and I say that if you stop the shoot between each two sets of leaves you can make young shoots come out, and therefore I recommend stopping them so as to get a mass of leaves all up the stem. On most plantations, if you look, you will find only just a tuft of leaves at the top; that is a great mistake. If the stem of the plant were to be covered with leaves from the ground upwards, you would get a great deal more timber than you otherwise would in the same number of years.

Is it an operation which could possibly be carried on profitably over a large area of forest?—Decidedly so.

Would it not require an enormous amount of manual labour?—I do not think that. If you stop a shoot near to the stem it will throw out a number of very small shoots; in other words, I think it is a very great waste of money as things stand at present. You do not get a good result; you allow limbs to grow, whereas we want straight timber.

But you have, I understand, made a practical arithmetical calculation that it is more profitable to employ a large amount of capital to induce these new leaves to be started than to leave the trees alone?—Yes, most decidedly, because you get a good result. I may say that I should never myself plant trees out in a forest under four or five feet high; then they would go out prepared; they would only want stopping gradually back, and you would have a gradually improving result.

How often would the tree require stopping back?—If you do it once in two or three years that would be sufficient.

Do you consider that there are large portions of land which might be more advantageously cultivated as forests in England than in any other way?—Yes, decidedly.

EARL OF DUCIE.

Could the process of planting with larch be carried out extensively in the Cotswolds?—It would depend upon whether the owner preferred to have it planted with timber or see it used as a sheep-walk. A great deal of it will no longer pay as arable land.

Will it pay as a sheep-walk?—It would pay a certain amount, but a very small rent indeed.

Would the land pay under forest cultivation?—I daresay it would; I see that a great many proprietors are devoting their land to larch, but I think Lord Bathurst might be better able to answer this question than I am.

EARL BATHURST.

What is the market value of beech now?—I should hardly like to say now, but we do not sell any good beech under 1s. a foot. The principle on which my woods are managed is that every year a certain number of acres are cut; the woodward goes through the woods, and upon that particular section, or sometimes generally in two or three different sections throughout the woods, he marks with a red spot or a red line round the small trees those which are to be left. Then the woods are marked out in drifts by stakes, the woodmen fell the standing underwood and the trees that are not marked and lay them in drifts; then every year I have an auction, and the timber buyers come round and bid against each other.

SIR J. CAMPBELL, MANAGER OF ROYAL FOREST OF DEAN.

Do you cut round the trees that you are going to transplant first?—No, I have taken up trees 25 years old, simply taking them up in winter and putting them in some other place.

Taking a very large ball to them?—Taking no ball to them at all, simply taking them up in the winter.

That would not apply to hollies would it?—I am speaking of oaks. It has been practised in the Forest of Dean since the beginning of the century. It is a very curious fact that the smallest tree that was transplanted in 1808 is double the size of the largest oak that was measured at the same time and not transplanted, although it was smaller at first.

Then according to that, I understand you, all oaks ought to be transplanted because they will grow larger?—Speaking within reason, the more you transplant them the better when they are young. I have trees now which have been lifted five or six times, and they are all going on very well; only a few of them have died. I have been very much struck with this: in the year 1860 or 1861 I wanted to know what was the cause of these trees having been growing so much faster from having been transplanted, and I selected a dozen growing within gunshot of each other, all seedlings. I knew they never had been planted; I took up six of them, marking them in a particular way. I took them up by digging them out of the ground, and I immediately replanted them in the same holes. I measured them all, taking the circumference of each tree six feet from the ground. In the first seven years the trees that had never been touched at all went ahead very fast, and the others grew very little; after seven years the others began to recover, and I think in this year, 1887, the six trees that were something like eight inches in circumference will now, in the aggregate, be bigger than those that were never touched at all, thereby showing that the mere fact of lifting an oak tree and putting it back into the ground and re-planting it, without doing anything else whatever to it, is a valuable treatment for an oak tree. People ask why this should be so. I say because if you have a thousand trees that you have to cut down because they are too thick in your plantation do not cut them down, but lift them and place them somewhere else or make a clump of them.

MR. MACGREGOR, HEAD FORESTER, ATHOL.

I will ask you now whether you have given your attention to the question of schools for instruction in forestry?—Yes, I have.

What is your general view of the question?—At the present time there is no means for a young man to learn anything about forestry but to go about to wood foresters and

work as a day labourer. The Highland Society have of recent years introduced examinations ; and they also offer premiums for essays on subjects connected with forestry.

I think you are one of the board of examiners of that society ?—Yes.

Perhaps you will give us the qualifications you require from the candidates ?—They are supposed to have a thorough acquaintance with the details of practical forestry ; a general knowledge of the following branches of study so far as these apply to forestry : The outlines of botany (that, of course, we have nothing to do with as examiners in practical matters ; there is another examiner for that ;) the nature and properties of soils, drainage and effects of climate ; land and timber measuring and surveying ; mechanics and construction as applied to fencing ; draining, bridging and road-making ; implements of forestry ; book-keeping and accounts. The examinations are open to candidates of any age. Then the syllabus of examination in the science of forestry and practical management of woods consists of : (1) Formation and ripening of wood ; predisposing causes of decay ; (2) Restoration of woodlands, consisting of, (1) Natural reproduction ; (2) Artificial planting ; (3) General management of plantation, cropping by rotation, trees recommended for different situations ; (4) Season, and methods of pruning, thinning, and felling ; (5) Circumstances unfavourable to the growth of trees ; (6) Mechanical appliances for conveying and converting timber, construction of saw mills ; (7) Qualities and uses of chief indigenous timbers ; processes of preserving timber ; (8) Management of nurseries ; seed sowing ; (9) Collection of forest produce ; (10) Manufacture of tar and charcoal ; (11) Insects injurious to trees ; preservation of birds which prey upon them, drawing a distinction between birds which are beneficial and those which are destructive to trees.

I believe you said the management of the Scotch forests might be much better than it is now ?—Yes.

In what respect ? Where does the deficiency now lie in the management of the Scotch forests ?—The deficiency lies in this, that if it is left to the forester he does not know when to begin to thin, or when to plant and what to do. Some men in charge of woods prune live branches off coniferous or resinous trees.

That bad management is in consequence of the ignorance of those who manage it I suppose ?—To a certain extent.

Could you say whether the great plantations on the Duke of Athole's property and elsewhere have had any effect on the climate ?—I think they have ; they shelter the low ground very much.

Have they affected the rainfall at all ?—I would not say that. I do not think there is any record kept of the rainfall before.

A former witness before the Committee said he thought the effect of planting forests was to make the climate more equable and temperate ?—That is the general opinion, I believe, but I could not say so from experience.

Have these plantations been successful as a commercial speculation ?—I think so.

But at present prices they are not ?—Even at present prices they are better than if left as moorland in their original state. Before 1879 we were getting 14*d.* and 15*d.* a foot for larch, and now it is down to 9*d.* and 10*d.* Scotch fir freely brought 8*d.* a cubic foot ; now it is only 4*d.*, and there is very little demand at that.

I suppose anything over 1*s.* a foot for larch pays well ?—Less than 1*s.* pays well.

MR. THOMSON, HEAD FORESTER, STRATHSPEY.

Are you able to say from your own experience whether these great plantations at Strathspey and elsewhere have had any effect on the climate ?—I think they have. I know of one plantation that was cut down. There was a spring of water in it before the trees were felled ; shortly after the trees were felled the spring dried ; now it is replanted again, and they are up four or five feet high, the waters have returned to the spring. The trees prevent evaporation.

Speaking generally, has the effect of the plantations on the surrounding agricultural land been beneficial or otherwise ?—They have been beneficial as far as shelter is concerned. A great number of farmers have applied to get a small portion of their farms inclosed for the sake of the shelter.

Can you say whether it has affected the rainfall or not?—I could not say whether it has, further than the instance I have given you about the spring.

REV. T. E. F. FLANNERY, P.P., GALWAY.

Is shelter very much wanted in Connemara for cattle and other stock?—It is very much wanted.

Do you think that a great benefit would be conferred upon the country in that way if there were masses of timber planted along some of the mountain sides?—It would be a very great benefit, and the land remaining would be drained; so that the land, even though not planted, would be rendered doubly valuable by planting the portion that would be selected for planting.

You said that the unplanted land would benefit by the planting; I think you said it would be drained?—I did.

What do you mean by that?—I mean that when you plant upon the side of a mountain you must have a fall of water either to the river or to the sea. It would necessitate driving a main drain either to some inlet or outlet to the sea, and the main drain would drain the land for many acres round where the tenants would raise their stock; the cattle would have shelter there and the land would be dry.

I suppose one of the great benefits arising from planting would be the employment and encouragement of labour amongst the industrial population; it would do a great deal of good to the country in that way, would it not?—Yes, but that should be a secondary matter; it would not be in that view at all that I would advocate it.

You see no difficulty in the way of attaining a profitable result?—I do not see the least difficulty. I am convinced, on the contrary, that there would be a profitable trade in the timber, and that within 90 years.

MR. GILCHRIST, HEAD WOODMAN, POWERSCOURT, ENNISKERRY.

Do you think, on the whole, the plantations in Ireland, as elsewhere, are not very profitably managed?—Yes, many of them are not very profitably managed.

What particular point do you think they fail in?—They fail in want of attention as to thinning. I have seen a great many losses occur through a want of attention to drainage; that is to say, the drains have been opened when the plantations were formed, and have been allowed to become filled with stagnant water for want of cleaning.

You consider your own forests have been profitably worked?—I think they have been profitably worked.

That is, I suppose, that you have a large quantity of larch, which can always hold its own against foreign timber?—Yes, no doubt it is due to that; and also there was a considerable quantity of hard wood that had been planted, probably about from 80 to 100 years ago, and we have been realising a lot of that by judicious thinning, not by clearance.

Do you think that your plantations in the future are likely to be as successful profitably as they have been in the past?—I think so.

Why should your experience have been more favourable than that of other countries; the Committee had Mr. Dundas from Scotland the other day who told them that they could not grow timber profitably in any part of Scotland?—I think the depression in the price will not last. I think that was owing to the great quantity of timber that was blown over by the recent gales, a large quantity of which is still unsold.

Is it not due to foreign competition too?—Yes; it is due to foreign competition, no doubt, but that cannot go on for ever. For instance, as regards these Norway spars, although brought in for next to nothing, they could not go on bringing them in at that price, and as they cut further from the coast the price will have to go up.

Would you recommend that the State should undertake the planting of timber in Ireland as a commercial undertaking or as a political undertaking?—I think I could safely recommend the State to undertake it as a commercial undertaking.

Did I understand you to say just now that upon some land that you had, after 25 years growth, the larch made a return of 25*l.* per acre?—I will give you the alder first.

The value of the land in this case was about 10s. per acre, and the crop of alder cleared after 50 years' growth yielded 3,300 cubic feet, equal to 55 $\frac{1}{2}$ l., and there was a fair crop of trees still left upon the ground; that was in 1883. Then, coming to the larch, we have larch of 80 years' growth, the present value of which is 80 $\frac{1}{2}$ l. I have no account of the thinnings out of that plantation.

I think I heard you say that from a 25 years' growth of larch you had a crop valued at 25 $\frac{1}{2}$ l. per acre?—Yes, and where they are about 50 years planted we have 140 trees to the acre, worth 3s. 6d. each, bringing 24 $\frac{1}{2}$ l. 10s. per acre. In this present year we thinned out 100 trees and sold them for 3s. each, making 16 $\frac{1}{2}$ l. 10s. realized for thinnings this year. In 1879 I thinned out of that same acre of land 100 trees and sold them at 1s. 6d. each, making 7 $\frac{1}{2}$ l. 10s.

What was the rental of the land?—The rental of the land would be a very high rent at 10s. per acre. I consider that at the very outside 7s. 6d. would be ample for that. Then, coming down to the larch, 25 years planted, at the present time there are 250 trees on an acre of ground, 25 $\frac{1}{2}$ l. value; that was thinned in 1885. There were 150 trees taken out which yielded 13 $\frac{1}{2}$ l. 2s. 6d. per acre. Thinned out in 1879 it yielded 200 trees at 1s.; that is 10 $\frac{1}{2}$ l.

What rental would that land be?—That is rather a better class of land. I should think it might be worth, for an agricultural tenant, 1 $\frac{1}{2}$ l. or so per acre.

There is very great probability, is there not, that the foreign supplies of timber will fall off in course of time?—I expect they will fall off.

The Committee have had some evidence that the Canadian and Scandinavian forests have been a good deal thinned of late, and that the supply from those sources is likely to fall off in the future; do you concur in that opinion?—I do concur in that opinion.

That would be partly the basis upon which you have founded your opinion that the market is likely to improve?—Yes; I think in Norway, when they cut a little further from the coast and have to pay increased carriage to the ship, the price will go up a little.

I gathered from your previous answer that you attached great importance to running a belt of shelter round outside the plantation?—Yes, a belt of Scotch firs round the outside, or of Austrian pine, which is a very hardy tree.

Do you think that if proper attention had been paid to that precaution three-fourths of the destruction which did occur might have been prevented?—I have had much experience in blown timber and have come to the conclusion that a great deal of it could be traced to pure mismanagement.

MR. EVAN POWELL, WALES.

You have had experience of planting?—Yes; we have planted very extensively.

And of the management of woods?—Yes; and of valuing and marketing timber, more especially in Wales, but also in other parts of the country; Devonshire for instance.

You have travelled a good deal in the United States and other foreign countries?—Yes; I am managing director of a company in the United States where lumbering is one of our operations.

Have you in your travels in foreign countries paid any visits to the foreign continental forest schools in Germany, for instance?—I have not visited any of the schools. I have visited some of the German forests but not the schools.

You are well acquainted, are you not, with the prospects of the timber trade, and as regards the quantity of timber imported from those countries?—Yes; more particularly from America, but I am also acquainted with the imports from other countries.

What is your opinion as to the future prospects of the timber trade?—I think that for some years the timber trade in this country will be very depressed, but I think the time will come when timber will be scarce here.

Do you think that there will be a good prospect for the home-grown timber?—I think that in the future there undoubtedly will be.

Could you give the Committee your reasons for that opinion?—Yes. I think that the future imports of timber are likely to very materially decrease; firstly, owing to the very few countries in Europe conserving a supply of timber equal to the demand in those

countries, for I think that with the exceptions of Germany and Bavaria there is no country in Europe that produces as much timber as is consumed in the country. Secondly, owing to the rapid denudation of the forests in the United States and Canada, and also in Sweden and Norway, judging from what I hear (for I have never visited those countries). In the United States of America, and in Canada also, there is an immense destruction of forests annually by fire. I have here the census reports of the United States in which they very carefully go into the production of timber and also the destruction of timber; and I think that it is estimated that in the year 1880 there was something over 10,000,000 acres destroyed by fire. Fires which do not affect the large timber will destroy all the young timber up to 15 or 20 years' growth; a fire that will run along the leaves and not materially injure the large timber will utterly destroy the young timber. Then again, throughout almost the whole of the United States there are cattle and stock running over forests, and the destruction by browsing to the young trees is something enormous. Then along nearly all the navigable rivers in the whole of the United States you will find that timber has been cleared away, and it is only as railways are developed through the country, or rivers are made navigable, that future timber lands are being opened up for supply, and as a matter of fact timber is selling at the present time on the eastern seaboard of the United States at higher prices than it is selling at here.

Do you consider that there is a diminution in the supply of home-grown timber at present?—Yes, I think that a very large amount of timber has been cut down within recent years and that an equivalent amount of young plantations have not been formed. I should say, as illustrating the rapid way in which the primeval forest is being cut in America, that in the case of our company we have had one mill there which has been clearing at the rate of nearly 1,000 acres a year of primeval forest.

Could you give the Committee what you consider to be the reasons for the diminished amount of planting and of the general growth of timber at present?—The diminished amount of planting is caused first, no doubt, by the scarcity of money and the depressed times, and also by the long period which the proprietor has to wait for a return of his money; I think, also, that that the rating of woodlands has had a deterring effect on planting. I think it was a most injudicious law to pass; it was just the last straw that broke the camel's back. Other countries are endeavouring to extend the planting of timber. In the United States, for example, as an encouragement to planting, all land planted is exempted from taxation, and not only that, but a premium or bounty is offered for planting. It seems to me England is taking less care for the conservancy of her woodlands than any other country.

I understood you to say that you thought that we had nothing to fear from America as regards the importation of foreign timber into this country?—At the present time there is a very large importation of timber from America to this country, and that is no doubt one of the causes that has brought timber down to its present price. For instance, we are having an enormous quantity of what is ordinarily called pitch pine, *pinus australis*, and from the Southern States of America. I had occasion, about four years ago, to inspect a large timber property there of nearly half a million acres, and I saw during my visit there that the timber had been cleared along the navigable rivers, where it was some distance from the river, in order to get rid of it; the trees were girdled one year and set fire to the next. I have seen thousands of acres of magnificent timber being burnt simply to clear the land for growing cotton. You can buy the land with the timber for a dollar and a quarter, or say five shillings, an acre, and after you have cleared the timber the land is worth more; consequently, timber can be had there for nothing except the cost of carting to the river and the manipulation of it. That is causing timber to be sent to this country now at excessively low rates.

In what States of America did you find that to be the case?—The timber which I inspected was in Georgia, but I have also inspected timber lands and heard the same thing spoken of in Tennessee, West Virginia and Florida.

In the north and west of the United States is there very little timber?—On the eastern seaboard of the United States, except in Georgia and Carolina, timber is getting very scarce indeed, and, in fact, they get nearly all their timber imported from further west.

Do you know whether Canada is sending much timber to this country at the present time?—Yes, it is sending a good deal; but the timber that used to be sent from Canada the Quebec yellow pine, has become almost worked out; there is hardly any of it obtainable now.

Is it not the case that there are large quantities of unenclosed woods where, if plantations were made, the trees would naturally seed and others would grow?—Yes.

But from the fact that those woods are unenclosed cattle get in?—Yes, cattle get in and kill the young shoots. But that is more so in Brecknockshire. In Montgomeryshire we have the woods more carefully fenced in. That would be one of the advantages of instruction in forestry, that people would understand that injury to the trees occurs not only from the cattle browsing the tops of the trees but from the animals rubbing against the trees and the grease from their bodies getting into the bark of the trees and preventing the sap flowing up the tree. People think that if the top of the tree has grown out of the reach of the cattle, they do not harm it, but it is a great mistake to suppose that injury is done by their rubbing against it as I have described.

Is not it a source of great danger to us if they attend more to their woodlands in Canada and in America than we do, and so send greater supplies of wood to compete with our woodlands here?—Yes; but so far it is all theoretical. Practically the only action taken on the part of the Government is to prevent the timber being stolen, and to try to prevent forest fires. A great deal of land is set on fire by persons who have the grazing of it merely to improve the pasturage. I have myself seen large tracts of land that have been fired merely to get a little more of the scanty pasturage.

Is the management of the woodlands in America worse now than it was formerly?—No, I should say not; if anything it is better. But there is hardly any attention given to the management of woods, further than cutting them down, so far as actually has come under my attention, although I have read that a great deal of attention is paid to the matter.

As a matter of fact, however, in America they have a vast quantity of wood of better quality than ours which effectually competes with our wood; does not that pretty clearly show that further attention to the subject of forestry is not necessary in America?—As I have already stated, I believe the price of timber in New York is higher than it is in England. Our company in West Virginia send a large quantity of timber to Richmond, New York and other places, and the price in New York must be higher than that at which timber is sold here.

Is that on account of the high railway rates in America?—No; the railway rates in America are very much less than they are here. As I said, we can send timber from West Virginia to New York, which is a distance of nearly 700 miles, for about the same cost as we could send it in this country for a distance of 150 miles.

REV. J. C. BROWN, LL.D.

Are there any old forests left in Spain?—There are a few, and the forest engineers in Spain have been struggling with the Government for the last 12 or 15 years to prevent the sale and utter destruction of those forests which still remain. The struggle is still going on. The newspapers generally are in favour of the forest engineers. They look not only to the supply of timber but to the climatic effect of the forests. The problem which the forest engineers of Spain virtually propose themselves is this, how can we secure that not a drop of rain shall fall in Spain without its being utilized, and the forests are employed as an important means of securing this object.

The want of thinning in Irish plantations; there is no doubt that that is a great defect in Irish forestry. Most people who have demesnes or lands in their own hands have plantations which have been planted in former days but which they have never thought at all of thinning, and the consequence is that the trees are being destroyed. Lord Carysfort and Lord Wicklow, in the county Wicklow, have very extensive plantations, mostly of oak, which has grown up naturally from the stools of the old trees which were cut down, for the most part, in the time of the Rebellion, I should suppose; but

those trees, for want of thinning, are now growing up into wretchedly thin poles and will never be worth sixpence. I have repeatedly spoken to both Lord Carysfort and Lord Wicklow on the subject of thinning their woods and they say that it does not pay them ; but I say even if it does not pay them they ought to thin them, because the woods are being utterly ruined.

INCREASING THE DURABILITY OF TIMBER.

In the present fast-growing scarcity of good pine, and many other woods, the question of wood-preservation becomes most important. Following this will be found methods in use in the States and other countries for preserving timber, the most approved plans being selected for detail. But here in Toronto we have a preservative used, which appears of great value, and as we mention the names of Americans and Europeans who have invented and who use different methods of creosoting, and other ways of preserving wood, it would seem unfair not to allow our own resident to have his say in the matter, especially, as from personal experience I can corroborate some of his statements. This is Mr. Finch, of Toronto, and he writes as follows of his method :—

“It is surprising that, seeing the enormous loss from the decay of lumber, means are not used for its prevention. There may be reasons—ignorance of the cause of decay and the uncertainty of finding an efficient remedy ; or the unspoken thought that the more waste, the more work, and the more cash expended in replacing it.

“It is admitted that the loss to Canada from this cause, would pay the yearly interest on the national debt ; and the Department of Forestry at Washington, D. C., estimates that the loss to the United States for railway ties alone amounts to twenty-five millions of dollars annually ; add to this, bridges, platforms, walks, wharves, box-cars, telegraph poles and all other cases where wood decays, and \$100,000,000 would not pay for this waste, which does nobody any good.

“Besides the loss, it is a prolific source of sickness, to which many physicians testify. The cause of the decay of lumber is not generally known ; it is thought to arise from slow combustion, and as everything decays lumber is no exception. Scientists now state that the microscope shows the real cause results from the growth of a fungus plant of the mushroom type on damp wood, feeding on the wood, undoing what has been done by the tree in growing, and returning it to its native element, the air and soil. In 1875, planks and cantlings for sidewalks in Toronto, were coated with a cheap, simple preservative and laid at the request of the council in different wards of the city, and after eight years use were found sound and free from decay, (sample planks can now be seen of that lumber) that on being cut, retained even the pine smell quite fresh. The explanation is, that when lumber is thus treated, that destroying agency cannot grow on the damp wood, and it becomes hardened, seasoned and undecayable. It can be done by unskilled labour when the lumber is piled. The preservative is laid on the lumber with a common broom ; it can remain in pile or ready for use as soon as dry ; no danger or risk in using it ; it will not easily burn. It has been used for railroad ties, railway platforms, warehouse floors, walks, sidewalks, scows, foundation planks under walls of warehouses ; on made land it is cheap,

safe, sanitary. No costly plant required. The cost of material and labour will be about \$2 to \$3 per 1000 feet board measure."

Wishing myself to see Mr. Finch's method in operation, I allowed him to coat the plank, above and below, of over a hundred feet in length in a lane of my own. This was about a year and a half ago. The effect has been very beneficial. Some of the planks were left untouched; these are evidently beginning to rot, while no sign of decay is manifest under the others—both new planks. In any future case of laying planking I should certainly, if available, obtain this preservative and apply it. This is a lane where damp seemed especially apt to rot the planks, but this year they seem to have kept remarkably dry and sound.

The following valuable hints are from the Washington department:—

People waste a large amount of timber and of labor by lack of care for the timber after it is cut. Rotting timbers and fenceposts necessitate not only the cutting of a large quantity of wood, but also the labor of replacing the same oftener than if the wood could be made to last longer.

There are some rules in the handling of timber which are too often overlooked, and which should be observed by everybody who uses wood in places where it can not be kept dry or wholly submerged.

There is also much unintelligent use of paints and other coatings, applied in the hope of preserving timber, when it should be well known that by painting green or badly-seasoned timber decay is hastened rather than prevented.

While to many it may be impossible to apply the more complicated and expensive methods of wood preservation which recommend themselves to large consumers of wood material, knowledge of the following considerations will aid the small consumer to handle his material to better advantage, to utilize forest products more thoroughly and intelligently, and to make them last from two to three times as long as when not observed.

(1) *Decay of wood* is due to fermentation of the sap, induced probably by the growth of either bacteria or fungi. These organisms need for their development warmth and moisture besides the nitrogenous substances and salts contained in solution of sap.

To prevent the growth of these ferments, therefore the sap in the wood must be dissolved, leached out, or dried out, and moisture be prevented from re-entering.

(2) *The manner of use influences durability of timber.*—Timber entirely submerged under water or in deep soil (drain pipes) will practically not decay, nor is it liable to rot when kept absolutely dry, away from the influence of humid atmosphere. Wood decays in proportion to the warmth of the temperature.

On northern exposures, in cool valleys, on high elevations in northern countries, the duration of wood is longer than when placed under opposite influences.

If wood is used in the ground, decay proceeds more rapidly (beginning with the point of contact with the soil) the looser, moister, and warmer the soil, and especially the greater liability of change from dry to wet; therefore timber will last longer in heavy, always moist, clay, than in loose, alternately moist and dry gravel, or in warm comparatively dry lime soil.

Rooms without ventilation induce decay, producing the dry-rot (which first appears in white patches, changing into brown or gray). Ventilation, drying out, and insulation from moisture will cure this defect.

(3) *Natural factors influencing durability.*—Sound mature trees yield more durable timber than either young or very old trees. Maturity is the time when trees have ceased to grow vigorously, which is indicated by a flattening of the crown, dying out of branches in the crown, and by the change of color of the bark. Maturity may be reached according to circumstances by the same species, when the diameter is only a few inches or when it is several feet. The small tree on arid soil, or overtopped by others from its birth, ma-

be as old and older than a tree of greater dimensions growing under more favorable conditions. Of two pieces of the same kind the heavier is the more durable, although absolute weight of two different kinds of timber does not determine their relative durability.

Heart-wood, as a rule, can resist deterioration longer than sap-wood, because it contains less sap; but when the sap-wood is well seasoned and heavier, this difference disappears.

The site has an influence on durability in so far as it influences the formation of heavy wood.

Quickly-grown hard woods with wide annual rings, and *slowly-grown conifers* with narrow (yet not too narrow) rings, and "tapped" pines (on the tapped side) yield, as a rule the most durable wood, other conditions being alike.

Conifer wood from poor soils, high altitude, and dense forest, hard woods from rich, deep, warm soils and isolated position, are most durable.

(5) *Time of felling*.—With proper after-treatment of the wood the time of felling seems not to affect its durability. Early winter felling (December) should have the preference, because less fermentable sap is then in the trees, and the timber will season with less care, more slowly and more evenly, and before the temperature is warm enough for fermentation to set in.

If the wood is cut "in the sap" it is more liable to fermentation and to the attacks of insects, and more care is necessary in seasoning; for the rapid seasoning, due to the warm, dry atmosphere, produces an outer seasoned coat which envelopes an unseasoned interior liable to decay. When cut in the leaf it is advantageous to let the tree lie full length until the leaves are thoroughly withered (two or three weeks) before cutting to size. With conifers this is good practice at any season, and if it can be done, all winter-felled trees should be left lying to leaf out in spring, by which most of the sap is worked out and evaporated.

(6) *Treatment after felling*.—Always remove the bark from felled timber to aid seasoning, but not from the standing tree.

Never allow the log to lie directly on the moist soil.

If winter-felled, shape the timber to size within two weeks after felling, and leave it placed on blocks—not upon the soil—in the forest, or if shaped at home place in a dry, airy—not windy—position away from sun or rain.

If dried too rapidly, wood warps and splits, the cracks collect water, and the timber is then easily attacked and destroyed by rot.

With large logs, checking may be prevented by coating the ends with some fatty or oily substance mixed with brick dust, or with a piece of linen cloth, or even paper, or by simply shading them to lessen evaporation; cracks on the sides may be filled in with tow or cotton.

When piling timber, place laths or sticks of uniform size at uniform distances under each log, or post, or tie.

Sufficiently thorough seasoning for most purposes is obtained in twelve to eighteen months, while for special work, according to the size, from two to ten years are required.

The best method of obtaining proper seasoning without costly apparatus in shorter time, is to immerse the prepared timber in water from one to three weeks, to dissolve the fermentable matter nearest the surface. This is best done in running water. If such is not at hand, a bath may be substituted, the water of which needs frequent change. Timber so treated, like raft timber will season more quickly and is known to be more durable.

If practicable, the application of boiling water or steam is an advantage in leeching out the sap.

(7) *Coatings to keep out moisture*.—Never apply paint or any other coating to green or unseasoned timber.

If the wood was not well dried or seasoned the coat will only hasten decay.

Good coatings consist of oily and resinous substances which make a smooth coat, capable of being uniformly applied. They must cover every part ; must not crack, and possess a certain amount of plasticity after drying.

Coal tar, with or without sand or plaster or pitch, especially if mixed with oil of turpentine and applied hot (thus penetrating more deeply) answers best. A mixture of three parts coal tar and one part clean, unsalted grease, to prevent the tar from drying until it has had time to fill the minute pores, is recommended. One barrel of coal tar (\$3 to \$4 a barrel) will cover three hundred posts. Wood tar is not serviceable because it does not dry.

Oil paints are next in value. Boiled linseed or any other drying vegetable—not animal—oils are used with lead or any other body (like pulverized charcoal) to give substance. Immersion in crude petroleum is also recommended.

Charring of those parts which come into contact with the ground can be considered only as an imperfect preservative, and unless it is carefully done, and a considerable layer of charcoal is formed, the effect is often detrimental, as the process both weakens the timber and produces cracks, thus exposing the interior to ferments.

WOOD PRESERVATION.

Wood is made up of small fibers, the various forms of which constitute its cell-structure. Air occupies the cells not filled with sap.

The woody fibre in all kinds of wood is composed of the same elements, and in nearly the same proportions. It consists of 52.4 parts of carbon, 5.7 parts of hydrogen, and 41.9 parts of oxygen.

Differences in the strength of timber are due to differences in structure, or in the form and disposition of the fibers. The specific gravity of the fiber is about 1.5.

The sap consists mainly of water, and of the so-called extractive substances, such as vegetable glue, gum, gallic acid, coloring matter, sugar, albumen, etc. Besides these substances, which are found in greater or smaller quantities in almost every kind of sap, that of some kinds of wood contains special ingredients ; oak contains tannin, the coniferous woods contain resin, essential oils, etc.

The quantity of sap contained in wood varies considerably in different kinds and at different seasons of the year. Freshly cut wood contains from 18 per cent. of sap (in Hornbeam) to 52 per cent. (in Black Poplar). The variation of sap at different seasons is illustrated by the observation that ash, cut in January, was found to contain 29 per cent. of sap, and 39 per cent. when cut in April.

When wood is thoroughly air-dried it still contains from 16 to 20 per cent. of water, and when air dried wood is exposed for a time to a temperature of 277° F., the quantity of water is reduced to $\frac{1}{4}$ or $\frac{1}{5}$ of what was left in the air-dried wood.

The woody fiber by itself does not seem liable to decay ; but the sap contained in it under favorable conditions undergoes fermentation, and fungi attack and destroy the fiber.

Fermentation, however, cannot take place except in the presence of air, of moisture, and of a temperature above the freezing point (32°), and below 150° F. If any one of these conditions is lacking, decay is impossible.

But if wood is to be exposed to conditions favorable to decay, special precautions and means can and should be adopted to prolong its usefulness. The sap being the prime cause of decay, it is plain that timber should be cut at a season when it contains the least quantity of it and the least amount of organic matter, viz., during the winter.

It is stated on good authority that wood of proper character and age, cut during January and then air-dried, resisted decay for fifteen and sixteen years ; whereas timber of the same kind, cut at different age and season, lasted only four years.

It is also evident that the total or partial removal of the sap from wood will retard its decay. But even if all sap were removed decay would naturally set in, if the entrance into the cells of air and water containing spores is permitted, or if no means are adopted to prevent their growth when introduced.

To prevent air and water from entering the wood its cells may be filled with some substance not liable to decay. To prevent organic life from springing up in the wood cells, antiseptics are introduced into them in the form of solutions, which act as poisons on all kinds of spores and bacteria.

NOTE.—There is no doubt whatever that wood can be preserved, successfully and to commercial advantage, to a much greater extent than is generally believed.

To experts in this field little need be said; they are aware of its extent, what has been accomplished, and the possible advantages. They know that the preservation of wood has been carried on in England and in several countries of Europe for a great many years on a very extensive scale and with the most satisfactory results, several processes being in use whose efficiency has been thoroughly established. Experience in this country has not been satisfactory, owing to a want of appreciation of certain conditions, very different from those found abroad. Among these it is noticeable that we have usually green timber to treat instead of seasoned wood, and that in some localities timber is yet too plentiful, and consequently cheap, to admit of a preserving process being employed to commercial advantage. In some cases again experiments have not been satisfactory, owing to the great distances to which wood had to be transported for treatment and then to be sent back,

The methods which are used, either simply or in combination with each other, in the preservation of wood, are,—

- (1) Steeping in water or in antiseptic solutions.
- (2) Forcing a current of water or of antiseptic solution longitudinally through the ducts of the wood, either by pressure or by suction—the Boucherie process.
- (3) Steaming in closed vessels.
- (4) Removing air and vapors from the cells by creating a vacuum around the wood in a closed vessel, and then injecting the antiseptic solution into the wood by applying pressure to the solution.—*H. Flad, St. Louis.*

ANTISEPTICS USED IN THE PRESERVATION OF WOOD.

Out of the great number of substances which, during the last sixty years, have been proposed for preserving wood from decay, or rather for prolonging the period of its usefulness, only four have stood the test applied, and are now employed for that purpose.

- 1st. Heavy oil of tar (creosote oil, dead oil).
- 2nd. Bichloride of mercury (corrosive sublimate).
- 3rd. Chloride of zinc.
- 4th. Sulphate of Copper.

In addition to these some substances are employed for preventing the gradual removal of these antiseptics from the wood by exposure to atmospheric influences, such as chloride of tannin, glue, tannin and sulphate of lime.

I may be permitted to quote from the recent and very instructive report on the preservation of timber, made in 1885, by a committee of the American Society of Engineers, after a careful and protracted examination of the subject :

“Conditions of success.—Your committee will therefore attempt to state the principal conditions to be observed to achieve success, as far as they have been disclosed by this investigation.

“(1) Select the appropriate process in view of the subsequent intended exposure of the timber.

“(2) Select the most open-grained, porous, and sappy varieties of wood to operate upon.

“Antiseptics penetrate but little into the dense structure of White Oak, Burr Oak, and Yellow or Heart Pine, and are of doubtful utility for White Pine, Chestnut or Spruce, while they readily impregnate and preserve the following varieties of wood: Hemlock, Sweet Gum, Mountain Pine, Loblolly Pine, Black Oak, Red Oak, Gray Oak, Water Oak, Beech, Poplar, Ash, Sour Oak, Cottonwood, Maple,

"The cheap woods, on the contrary, can be made to outlast the best woods in their natural state by a thorough artificial preparation.

"For railroad ties it will be advisable to select the harder kinds of wood to guard them against cutting into by the rails, especially upon curves. Preservation, however, materially adds to the natural hardness of timber, and it is found to resist cutting by the rail, under ordinary traffic, from 12 to 16 years.

"(4) Extract the sap and water, as far as practicable, before injecting the preservative. It is obvious that a liquid solution cannot be forced in unless there is a place for it, and yet most of the failures of valuable methods can be traced to neglect of this obvious requirement. Timber must be well seasoned either naturally or artificially before the antiseptic is injected—except in the case of the Boucherie process, which can only be applied to freshly cut logs.

"The Europeans operate, as has been stated, upon timber which has been cut and seasoned six months or more, and hence they find little trouble in injecting the solutions. In this country we must operate chiefly upon green or freshly cut timber, and hence must resort to steaming, if we use the pressure method of injection. Very good results are accomplished by steaming, but the work must be well done, and at such heat and pressure as not to injure the fiber.

"(5) Put in enough of the antiseptic to accomplish the desired result, and make sure that its quality and strength are such as neither to injure the fiber of the wood nor to leave it unprotected.

"(6) After the wood is prepared allow it to dry as much as practicable before using. Its durability will be materially increased by getting rid of surplus moisture.

"(7) Let there be no undue haste in carrying on the work. This is sure to result in unsatisfactory preparation.

"(8) In laying prepared ties or timber in the track protect them from moisture or water, as far as practicable, by draining the road-bed.

"(9) Contract with none but reliable parties. As an inspection subsequent to the doing of the work, short of chemical analysis, does not establish the fact whether it has been well done, and the results cannot be detected for some years, there will always be a great temptation to do bad or careless work under contracts. The safe course, therefore, for those who decide to have timber preserved is either :

"(a) To do the work themselves under the supervision of experts ;

"(b) To contract it at a sufficient price to honest and skillful parties, keeping an inspector at the works to note the daily working, when the magnitude of the order will warrant it ; or

"(c) Contract the work on such terms that the profits shall depend upon the results accomplished in preserving the wood against decay."—*Washington Circular*.

REPORT ON WOOD-CREOSOTE OIL.

BY WILLIAM H. BIXBY,

Captain of Engineers, U. S. A. ; Member of the American, British, and French Societies of Engineers ; Member of the American and British A. A. S.

The Southern Pine (*Pinus palustris*, Linn.) has already made a brilliant record for itself in the past through its valuable products in the shape of turpentine, pitch, tar, and rosin ; but there remains for it a much more brilliant career in the future through its newer products wood-creosote oil and pine-leaf fiber, the oil being used mainly for preserving lumber, and the fiber for the manufacture of pillows, mattresses and carpet matting.

Creosote is a general name applied to the oil products obtained by the destructive distillation of wood, coal, and other carbonaceous fuels after the temperature has risen above 200° or 300° F. If obtained by the distillation of coal, or coal tar, this creosote is termed "dead oil," or coal tar creosote-oil; if obtained from the distillation of wood, or wood-tar, it is termed wood creosote-oil.

Heavy resined, "fatty pine" wood, subjected to a heat of from 200° to 760° F., within closed iron cylinders, yields by distillation and condensation: (1) a wood gas; (2) a small amount of wood naphtha; (3) a large amount of pyroligneous acid; (4) a large amount of wood-creosote oil; (5) a small amount of wood bitumen; and (6) a large amount of charcoal. Nine cords of good wood will yield a few gallons of naphtha and bitumen, 14 barrels of oil, 10 barrels of acid, and 168 barrels of charcoal.

The wood-creosote oil produced by this process is a dark, brownish, black oil, slightly heavier than water (3° to 4° Baume), with a strong creosote odor, and possessing valuable antiseptic properties. Upon analysis it is found to contain about 5 per cent. of tar acids, about 15 per cent. of lighter oils, and 80 per cent. of heavy oils, which are insoluble in ether, fresh, brackish, or salt water. This oil is an efficient poison to minute animal and vegetable life, and possesses an odor apparently intensely disagreeable to such life; it thoroughly repels moisture, and its tar-acids possess the power of coagulating albuminous and other fermentable matter. When properly prepared for such use, it has been found to be an excellent insecticide, to be employed on trees and smaller plants, especially for the destruction of larva attacking rose bushes, as also for destroying vermin on animals, in the cracks of floors, and in wooden buildings, and one of the best possible oils for preserving lumber and piling.

Experience in England and in the United States is unanimous in agreeing that creosoting is the only reliable method, so far tried, for preserving timber when exposed to salt water (and the *Teredo* worm), or to alternations of wetting and drying by either fresh or salt water. This experience also shows that the preservation of the timber is due mainly to those creosote oils which require over 400° F. for their volatilization, and that the pure creosote (with less tar-acids and with less light-oils) gives the best results.

Wood-creosote oil is much less expensive, and in many ways much more valuable, than the ordinary dead oil or coal-tar creosote oil heretofore used for such purposes as the preservation of timber. Wood-creosote oil contains all the acids needed to properly coagulate the albumen and sap which may be left in the timber, and to thoroughly destroy and prevent all further animal and vegetable life; it is of such nature that it will penetrate the wood both deeply and thoroughly; it contains a large proportion of insoluble matter, and especially of those oils which volatilize only under a heat of over 400° F.; and being derived from wood, it is especially adapted to use with wood.

In all these particulars, as well as in its less cost, the resinous wood-creosote oil is superior to the bituminous coal-tar creosote oil (or dead oil), and, dollar for dollar, it will give far superior results in the preservation of timber from destruction and decay.

Applied with an ordinary brush to wooden or metal surfaces of all kinds, two coats of this oil (with an interval of two months between the the applications) will effectually preserve these surfaces from wet and dry rot, from rust, and from the attacks of worms and insects. Forced into the wood by hydraulic pressure, this oil will fill all the pores of the wood and extend its coagulating and antiseptic effects entirely through the wood to its very centre.

The comparative invulnerability to fire possessed by wood that has been treated with this oil has been proved at the burning, in the fall of 1886, of the Atlantic and North Carolina Railroad wharf, at Morehead City, N.C., where the creosoted fender piles remained almost without damage by fire, while the wharf and sheds next to them were burned down entirely. Live coals and ordinary flames are unable to kindle any fire in wood impregnated with this wood creosote oil.

The general features of the process of distillation and subsequent use of this oil are as follows:

Ordinary "light wood" (or "fatty pine" wood) is cut up into sticks of about 4 feet in length, and about five cords of these sticks closely packed inside of a large cylindrical iron retort. The doors of this retort are then closed and hermetically sealed. A fire is

then built in the furnace under the retort, and the heat and flames are directed as uniformly as possible all around the outside of the retort. As the temperature inside the retort increases from 100° to 700° F., the liquid and some of the solid portions of the wood are converted into gas and vapor, and pass out of the retort through a copper "worm" enclosed in a cold-water tank and are collected in the form of wood gas, naphtha, acid, and oil. When the oil ceases to run, the fires under the retort are put out, the bitumen is drawn off through a tube coming from the bottom of the retort, and the latter is then allowed to cool off. As soon as possible, therefore, the doors of the retort are opened and the charcoal raked out. The operation is thus finished, and the retorts are ready for a fresh charge.

Timber and lumber which is to be treated with this oil must be first prepared to receive it. Timber is taken directly from the river by large derricks, is landed on the wharf, is stripped of its bark, and then exposed to the sun for a week or ten days to dry. At the end of this time it is placed (one stick at a time) on trucks, is rolled into the carbonizing cylinder, is there exposed from about ten to twenty minutes to an intense radiated heat, and is then withdrawn charred to a depth of one-fourth of an inch, thoroughly dried to the depth of three-fourths of an inch, and thoroughly heated to a depth of several inches.

The carbonizing cylinder consists of a wrought-iron cylindrical tube about 21 feet long by 28 inches in diameter, set in a brick furnace, fired at the side and midway of its length, the cylinder being brought to a proper and uniform heat by means of a wood fire, the heat and flames of which pass by vertical and horizontal flues along and all around the cylinder. The cylinder is further provided with a small railroad track and iron carriage on the inside, for the convenient handling of the timber. Sawn lumber is not usually charred, but is sometimes kiln-dried or semi-charred; the objection to the charring being that it destroys the sharp edges of the lumber. The charring or carbonizing of the process, therefore, consists in taking the timber and subjecting it to a dry radiant heat within the suitable cylindrical surfaces in such manner, as to drive out of the timber most of its sap and albuminous matter (ordinarily about five pounds to the square foot), drying the inside of the timber, charring its outside, and leaving the wood with its pores open and in condition to be completely filled with the wood-creosote oil thereafter applied to it.

Charred timber, once thoroughly carbonized, will not crack under subsequent exposure to the sun and air. If further properly treated with wood-creosote oil, it will withstand all attacks of atmosphere, moisture, and animal life, and will last for years anywhere.

This process for carbonizing and creosoting timber is such that it does not injure the fiber of the interior of the wood. It is one of the simplest, cheapest, quickest, most effective, and most successful processes so far known for artificially seasoning and preserving wet or green timber, in cases where the want of time or money do not allow a thorough natural seasoning of at least six months exposure to the atmosphere. Although other and improperly applied methods of dry-heating and after-creosoting may render timber brittle under the pile-driver, none of the timber so far carbonized and wood-creosoted has proved objectionable from this cause. On the contrary, the wood-creosote restores the toughness and elasticity to the charred wood, so that this method has given great satisfaction wherever used, as, for example, at Aspinwall, Panama, under the Panama Canal Company; and at Charleston, S. C., under the Northeastern Railroad Company; in both cases under circumstances extremely unfavorable to the life of the timber.

After the wood has been carbonized or kiln-dried, it is loaded upon trucks, which, with their load, are rolled into the creosoting cylinders, respectively of 65, 75, and 90 feet in length, each with a diameter of 6 feet. The doors of the creosoting cylinder are then closed for from four to fifteen hours, during which time temperature within the cylinder is raised by dry heat to from 140° to 160° Fr., a vacuum of from 9 to 24 inches is kept up by means of a vacuum-pump, and the sap, albumen, and other impurities are thus thoroughly extracted from the wood and pumped out of the cylinder.

The vacuum-pump is then stopped and a force-pump put to work, by which the cylinder is filled with hot wood-creosote oil, under a pressure of from 65 to 100 pounds per square inch, this pressure being constant from four to eight hours, according to cir-

circumstances. By this part of the process from eight to twenty pounds of oil are forced into each cubic foot of wood. The pressure is then relaxed; the unabsorbed oil is then run off into outside tanks, the doors of the cylinders opened, and the impregnated timber, still on its trucks, is rolled out.

This treatment with wood-cresote oil, as above described, has been favorably reported upon (March 18, 1886) by a special board of United States Navy officers; and the wood so treated has had an extensive use already upon the Government wharf at Charleston, S. C., at the jetties at Port Eads in the M. T. and E. P. Inclined Railway at Cincinnati, Ohio, as well as in many other less important places and structures.

Treatment with this oil is especially valuable to wood that is to be used in the construction of bath-houses, wharves, docks, quays, piers, railroad bridges, railroad trestles, wooden pavements, flats, lighters, scows, ship spars and masts, ship decks and bottoms, or used in railroad cross-ties, foundation sills for houses, piazzas, porches, floors, fence-posts, and telegraph poles. No cases have yet been discovered where either rot or *Teredo* has attacked wood that was thoroughly impregnated with this wood-cresote oil.

SEEDLING DISTRIBUTION.

From the annual report for 1886-'87 of the Conservator of the Woods and Forests department of South Australia, J. Ednie Brown, we take the following notes, of value for our own consideration:—

For the encouragement of tree-planting in the colony, 213,061 plants were distributed to 766 persons. In order that the free distribution of trees might be made as public as possible, a notice in regard to it was published in the Government Gazette for several months. Up to date, \$9,500 have been spent by the Government in raising trees for free distribution, and from reports received there are 565,000 trees alive, costing the Government $1\frac{1}{2}$ cents each.

"Of all the operations of the department, I consider there is none more important than that of this free distribution of trees."

Even Prussia, with a model state forestry and a highly developed private forestry, found it desirable to distribute from the Government nurseries during the last year 38,000,000 seedlings free of charge and 24,000 pounds of seed at nominal cost. The funds provided for this Division during the last year have allowed the purchase of about 300 pounds of seed and a contract for about 50,000 seedlings. Although no publicity was given to this part of the work, applications have been quite numerous and the stock on hand was soon exhausted. In addition several thousand tree-willow cuttings, grown by the Superintendent of Grounds, were distributed. The Division has directed its attention mainly to the economically valuable conifers, because they are or appear to be more difficult to handle by the inexperienced planter and consequently do not attract him sufficiently; yet they are among the most useful and desirable forest trees, especially in mixture with deciduous-leaved trees. Another consideration which made the purchase of conifer seeds more desirable is, that most of these will retain their germinating power longer than seeds of most deciduous-leaved trees and can therefore be kept without as much danger of loss.

In the absence of a proper system of obtaining applications at the right season this caution is very necessary.

A tentative plan has been instituted in supplying seedlings directly from the nursery, which has so far worked entirely satisfactorily. A contract has been made with a nurseryman to supply seedlings to a certain amount on requisitions made from time to time by the Department. The orders are filled directly from the nursery, in the usual manner of nursery business; a letter of advice with a form for acknowledgment of receipt goes to the applicant, which, together with the acknowledgment of the order by the nurseryman, establishes a perfect system of accounting. This plan, so far, could only be inaugurated with one nurseryman on a small scale; but should an extension of this manner of supplying plant material be made possible, a nursery in each of the tree-planting States should

be so engaged, in order to divide the business and to obtain the plant material as near as possible to the locality where it is to be used, which is desirable.

One nurseryman doing a large business, to whom the contract was offered but who could not take it, expresses himself on this plan as follows:—

Whilst I am aware that most nurserymen might be opposed to this new system of free distribution, I am sure it will be a good thing for the country; it will awaken a greater interest in forest-tree planting than could have been done by any other method. I am sure this enterprise can not fail in bringing about the greatest revival in tree-planting ever known in any country.—*Washington Forestry Report.*

THINNING PLANTATIONS.

The first mention of thinning for the purpose of benefiting the remaining growth dates back at least to the year 1547, but ever since the practitioners have differed more or less in regard to the manner in which to proceed. The golden rule, "early, often, moderately," has found the largest number of followers, each one differing as to the precise meaning of the prescription; but the most advanced teachers of forestry seem to see the advantage of more decided interference in the development of forest growth and about to prove by experiment the superiority of their doctrine. That the time and degree of thinning must differ with the different species, different soils, and localities, needs hardly to be mentioned. A few records of actual results, reported from reliable sources, may serve as suggestions and illustrations of the importance of this line of experiment:

A natural growth of pine (Scotch) which was thinned when six years old showed an increased rate of accretion three times as great as that of the part not thinned, which was also deficient in height growth.

A fifty-year-old-spruce (Norway) growth, having been twice thinned, showed an average accretion 12 per cent. greater than the part not thinned.

A growth of spruce (natural sowing), slightly mixed with maple, aspen, willow, and iron-wood, when fifteen years old was opened to the poor population to take out fire-wood; thus one-half of the growth for a few years was thinned out irregularly. The part thus thinned eighteen years later contained four and one-half times more wood than the undisturbed part; the former contained trees of from 1 to 9 inches in diameter and 15 to 65 feet in height; the latter did not produce any trees above 5 inches in diameter and 48 feet in height.

Another experiment, made upon a pine growth fifty years old, showed that by inter-lucation the rate of growth within eleven years stood three to one and three-fourths in favor of the thinned part.

Another writer planted Scotch Pine 6 feet apart; two years later he planted the same ground to bring the stand to 3 feet apart; he thinned when fifteen years old, and carefully measured contents when twenty years old. Although the plantation was stocked on poor soil, yet the average annual accretion was found to be 2.43 cords (Austrian) per acre, a yield "which is unexcelled." The writer adds that "if in such growths the number of trees is reduced in the fifteenth to twentieth years to 280 trees per acre, the yield in sixty years might equal that obtained in one hundred or one hundred and fifty years in the old manner."

A plantation of Norway Spruce, made with seed, was when thirty-three years old still so dense that it was impenetrable; hardly any increase was noticeable and the trees were covered with lichens. When thirty-five years old it was thinned, and again, when forty-two years old the condition of the growth was such as to make a thinning appear desirable; between the two thinnings, within seven years, the accretion had increased by 160 per cent., or 27 per cent. yearly in the average, and the appearance of the trees had changed for the better.

A coppice of Tanbark Oak was thinned when fifteen years old on half the area; when twenty years old both parts were cut, and it was found that the thinned part yielded more wood and more and better bark than the unthinned part, and yielded in money 14.5 per cent. more, although no higher price was asked for the better bark.

An area of 12 acres was planted, one-half with two-year-old pine seedlings from the forest, the other half was seed.

These thinnings were made with the following yield of round fire-wood (cut to billet length and over $2\frac{3}{4}$ inches in diameter) and brush-wood (less than $2\frac{3}{4}$ inches in diameter).

The planted part yielded at the thinnings :

When—	Fire-wood.	Brush.
	<i>Cords.</i>	<i>Cords.</i>
10 years old	1.4	1.4
15 years old	4.9	2.8
18 years old	4.5	2.8
Total	10.8	7

The sowing was first thinned when eight years old, yielding :

When—	Fire-wood.	Brush.
	<i>Cords.</i>	<i>Cords.</i>
8 years old		2.8
10 years old		3.6
20 years old	3.2	1.4
Total	3.2	7.8

In twenty-four years the total yield, inclusive of thinning, was :

	Cubic feet of solid wood.
Planted part	3,495
Sowed part	1,998
In favor of planted part	1,497

The following records of trials with different widths of planting belong in the same class of investigations, since the experiments as to the best methods of thinning reduce themselves to the question of the most advantageous number of trees to be grown per acre :

Two areas with the same soil conditions were planted with beech (with sod), six years old : A, at a distance of 6 feet ; B, at a distance of 2 feet.

	Fourth year (best trees).		Fifteenth year (best trees).	
	Diameter.	Height.	Diameter.	Height.
	<i>Inches.</i>	<i>Feet.</i>	<i>Inches.</i>	<i>Feet.</i>
A	3.9	$24\frac{1}{8}$	7.7	50
B	1.7	$18\frac{3}{8}$	4.3	$42\frac{1}{2}$

REPORT ON PULP MANUFACTURE FROM WOOD.

(BY DR. OTTO HAHN).

It is easily seen how great the importance of the accompanying report, sent in by Dr. Hahn to the Dominion Government, is to Canada. In getting out pine timber, the waste of great chips, slabs, lengths containing some imperfection, and so on, is enormous. These could all be utilized for fibre. Besides this, we have great quantities of aspen, which trees spring up wherever the forest is burnt—often where it has been thinned for timber. With such possibilities in view, we should take all care of those forests which we possess, principally pine, over which, in some cases, lumbermen have cut and cut again, till all left is thought useless for timber. But it would be by no means useless for pulp. It would be an excellent commencement, if a factory were started with the view of commencing to supply the European market. Such a factory would at once demonstrate what opportunities were really open, and discover what difficulties, if any, existed in the way. Once make use of the chips and rubbish of the lumberman's operations, and the question of forest preservation is in a fair way to be settled. It may be that the pulp manufacture will do it for us. At all events, it will open up an additional market for our timber.

REUTHUGEN, 18th July, 1886.

SIR,—The manufacture of paper out of wood-fibre from fir and aspen has, as you are probably aware, been in operation for several years. This was at first performed by a mechanical process which produced the wood to a pulp. Professor Mitscherlich, however, has since brought out a process of treating wood by a chemical agency—by boiling it in sulphuric acid—and the product of this process is rapidly superseding that prepared by the old pulping process,

A friend of mine, who is a director of one of the largest paper mills in Germany, writes me as follows:—

“The accompanying are samples of a new fibre material which as now prepared in enormous quantities, is found to have an immense influence on the paper making industry. There are factories which turn out as much as fifty tons of it a day.”

The invention was covered by a patent until recently, and the inventor has made a large fortune out of royalties. The Imperial law courts have now caused the patent rights to be cancelled, as the process appears to have been revealed to Professor Mitscherlich by a Scotchman.

It has occurred to me that Canada is destined to turn to account its vast resources of forests, and of sulphur, which latter exists so largely in the deposits of pyrites, in connection with the manufacture of paper for the continental or even the international requirements.

If our existing supply of wood were to be devoted to the paper industry, it would soon be exhausted, and prices would rise very much.

With the profits to be derived from Canada's forests resources in this direction, the railway debt could easily be paid off, and settlers instead of burning the pine and fir, might obtain a substantial return for that which they are compelled to destroy.

If the idea I have thrown out should meet with any support in Canada, I should be prepared, with my friend, to arrange for the promotion of a company in Germany for the utilization in a large way of Canadian wood fibre.

At the Universal Exhibition in Paris, 1867, the firm of Mr. Volter in Heidenheim (Wurtemberg) exhibited for the first time a new sort of paper pulp, prepared of pine

wood. This pulp had been ground by means of iron or steel rollers. On account of its cheapness, in comparison to pulp from rags, this pine wood pulp was very easily sold. But it was only fit for the inferior sorts of paper, for the fibres became too short by this process of grinding them, and the paper afforded too little firmness and tenacity. Eight years ago Professor Mitscherlich discovered a chemical process for manufacturing the wood fibre by solving the wood in sulphuric-acid and thus making so called cellulose (lignine). For this process he took out a patent in Germany and other countries, but by the legal verdict of the Supreme Court of Justice in German this patent was cancelled, because before the conferring of this patent the process had already been published in a scientific paper. Thus the manufacture of cellulose is now free in Germany. Mitscherlich demanded from each manufacturer a license of 10,000 marks, and then two marks each 100 kilograms of the produce. This license is now annulled. In the meanwhile the cellulose has replaced almost all the other substitutes in the paper industry, and there is no doubt that this process will continue in still larger proportions. The use of cellulose has no limits at all and depends only on the conditions that we can dispose of a sufficient quantity of the pine wood, of water for washing the cellulose, and of the opportunity to conduct the waste water into the rivers. These two conditions are not easily to be had in Germany, for lately the cellulose factories are classed among the burdensome establishments, and by this their erection is aggravated and its cost enhanced. According to the "Annuaire de la Papeterie Universelle de 1886," (General Annals of the Paper Trade) the different countries have the following numbers of paper mills and machines :—

Possessed by	Paper Mills.	Machines.	Tubs or Chests.
France.....	420	525	
Great Britain—			
England..... 280 430	361	541	140.
Scotland..... 68 98			
Ireland..... 13 13			
Belgium.....	30	48	
Denmark.....	10	10	
Spain.....	72	47	
Portugal.....	16	7	
Greece.....	1	1	
Holland.....	61	40	80
Italy.....	228	158	300.
Russia.....	133	137	
Sweden.....	48	26	
Norway.....	8	8	
Roumania.....	3	3	
India.....	6	4	
Japan.....	6	6	
Syria.....	1		
Island Mauritius.....	1		
Egypt.....	1		
Australia.....	4	6	
New Zealand.....	2	1	
Canada.....	36	44	
Mexico.....	11	12	
Cuba.....	1	2	
Argentine.....	3	3	
Brazil.....	5	4	
Venezuela.....	1	1	
United States of North America.....	884	1,106	
Further, according to the Address Book of Gunther Staib, Biberach, XI Edition, 1886—			
Germany.....	809	891	
Austria, Hungary.....	220	273	
Switzerland.....	35	46	
Luxembourg.....	2	2	
Total sum.....	3,419	3,952	520

Supposing now each of these 3,952 machines has a daily production of only two tons, we obtain a yearly consumption of paper pulp amounting to at least $2 \times 3,952 \times 300 = 2,371,200$ tons, or nearly 2,400,000 tons a year. Where now to get the raw materials for such an immense production of paper? Here the thought swerves involuntarily over to Canada. In its abundance of vast pine woods and clear water, the discharge of which is in our country objected to, Canada alone has the possibility of meeting the wants of the world for this new branch of industry. Suppose the yearly produce of paper to amount to 2,400,000 of tons and half of this weight, say 1,200,000 of tons, to be made of wood pulp, and further, that each ton of finished paper requires three tons of wood pulp, then the total consumption of paper demands 3,600,000 of tons of pine wood. But Canada furnishes besides the wood still other important additional materials for the manufacture; for instance, coal for firing, and common iron pyrites for distilling the sulphuric acid. Canada possesses all these raw materials in the vicinity of its shipping ports. The freight from Canada to Europe can therefore not come into consideration against these enormous advantages. But till now a great part of the wood adapted for paper manufacture is simply burnt in Canada. Let us suppose that Canada is able to furnish only half of these 3,600,000 of tons, say about 1,800,000 tons every year, and let us further calculate the ton of pine wood at 100 to 120 marks, as it will cost in Germany, we obtain for Canada a gross receipt of 198,000,000 of marks, from which the freight expenses are to be deducted. But even these expenses remain again in Canada for the benefit of either its inland economy, or of its equipment. The author thinks it his urgent duty to call the attention of the Government to this favorable opportunity of so immensely increasing the receipts as well of the Government, which has the sole right on all the wood on its land, as of private persons. The writer now proposes that your Government should take this matter in hand and make arrangements for the manufacture of pine wood pulp, whereby Canada may also retain the profits from this work.

The European production suffers everywhere from two facts:—1. From the high prices of wood, which will more and more increase in consequence of this industry. 2. From the difficulties of establishment, the necessary water not being at disposal, neither in sufficient quantity nor clearness, and finally, what is worse of all, that no favorable discharge is to be had, because the drainage of the waste water into the rivers is not permitted on account of the fishing, water works and so on. I submit now to your Government samples of (1) bleached pulp, (2) of raw paper pulp, (3) of raw paper pulp bleached and dried. The latter costs 40 marks per 100 kilograms. By personal observation made with one of the first engineers in the German paper trade, I am willing and able to give the necessary instruction for the establishment of cellulose manufacture, and also to make arrangements for the sale of the finished pulp in Europe, and am waiting for corresponding directions. Just now I read in the weekly paper of Gunther Staib from *The Paper Review*:—"The 'Vistula' brought from Germany 1,600 bales of German cellulose to Leith. The value of this cargo amounts to £2,500."

The utilisation of the material increases every day, and the price per hundred weight is now about 15 marks. Imagine the number of hundred weights that Canada's forests would furnish. If war does not break out in the meantime, I shall send my son to Canada in the course of the present year to investigate the matter more thoroughly.

I have the honor to be, Sir,

Your obedient servant,

OTTO HAHN.

To the Honorable
The Minister of Agriculture,
Ottawa.

TREATMENT OF PARKS.

In the treatment of city and town parks, a most important matter in Canadian forestry, where we have often few trees left near us, save those conserved in these, a lesson can be learned from the management of the chief park in our chief city. I have lately taken an opportunity of examining it pretty thoroughly, and would be glad to mention to your readers the results of my observations, and without endeavoring to attack gentlemen who have, of course, been acting in what they considered the public interest, will mention some points in which my method of procedure would have differed from theirs, and to give the reasons why.

When that great-hearted gentleman, Mr. Howard, the chief benefactor Toronto has ever known, gave his property to the city, valley and upland were largely covered with wild-wood groves, bright in all the pristine magnificence of their sylvan beauty. Tangled ravines were there, rich in cedar and springing underwood; gentle slopes of rising ground, densely clad with white-stemmed and waving birch trees—here and there hundreds of oaks, here and there many a grove of dark-browed pine. Few Canadian trees were unrepresented. It was a large and strangely pleasing wilderness—a portion of the earth as the Almighty had left it—a fragment of beauty—the solitary fragment for many a mile—unmarred by the axeman's destroying hand. Little brooks, fed and nourished by its uncleared glades and wealth of clustering underwood, rippled through its ravines. The Humber Bay, its white beach fringed by large trees, lay to the south, and that pretty little sheet of water, the Grenadier Pond, was on the west, a grove bordering its shore. The park was not forest alone; there were many open spaces—seventy or eighty acres of grassy land. But its chief beauty was its spreading woods, and chief of these their undergrowth. There, deep in valley and far along hillside, in every successive summer month, bloomed millions of flowers, not all gorgeous, but all interesting. The forest trees flourished in their native grace, the underwood grew unscathed and luxuriant between. Glancing into the ravines, scanning the hillsides, all alike was a bewildering succession of many shaped foliage—all was fresh, bright and shade-giving, and you knew what the greenwood which once covered Canada had been. This locality I had often visited.

I knew each glen and every alley green,
Dingle and bosky bourn of that wild wood,
And every shady bower from side to side.

Such an expanse of forest—so vast a stretch of native wilderness—so close to Toronto, conferred on the residents of the city, was a gift which, rightly used, might be considered almost inestimable. Tired of hot streets and glaring sun, the citizen, in a twenty minutes ride could have immersed himself deep in the shade of the forest, as it was when the Frenchmen manned Fort Rouille, or when Fitzgibbon's Indians found safety in its glades, and their red-coated allies death in its waters. Still the trees waved dark above—the flowering plants trailed and clustered dense below—the rivulets flowed along the valleys. What should have been done with such a place?

Clearly, it seems to me, by every means, to preserve the forest surroundings—the calm quietude of the ever-growing, ever-dying leaves. Paths should, indeed, have been

made across the park and through the woods in various directions, but they should have been foot-paths, not carriage-ways. Neither cutting down of slopes nor filling of ravines would have been necessary for these. Stone steps, such as are seen in other lands, would have rendered easy the ascent of the little elevations, a couple of planks would have made walking possible, without cutting hillsides away in the slopes, while many of the paths would have been over level ground. Millions of visitors would have passed along these shaded and pleasant paths, enjoying the beauty of the woods, the fragrance of the forest air, nor caring to enter the deep recesses they saw on either hand. Those who chose to enter them would have done no harm, always supposing they were prohibited from carrying off roots or barking trees. The park might have been a forest park for ever—a place as superior for health, for amusement, for relaxation, for retirement, to a mere grass-covered expanse with scattered trees, as it is possible to conceive. Leave to wander through a beautiful forest is one thing; being turned out to grass in a large paddock is quite another. It must also be noticed that so far as pavilions, swings, ball-playing areas, or the like, were concerned, there was no need whatever to interfere with the groves for these. The open spaces were already, as stated above, many times too ample for such purposes.

But the principle upon which the management of the park is conducted seems to me intended to change the original forest park into a large, poorly-grassed space, with trees here and there indeed, but very much fewer than at present, and so left as to allow as open a view as possible among them—a plan which, to my mind, resembles that of the gentleman who proposed pulling down all the houses, so that the people might see the town. A large portion of the grove has last spring been cleared of underwood by running fire through it—setting fire, I am informed by gentlemen living close by, to the dry leaves and rubbish, and having workmen engaged in managing its progress, and keeping it from the fences. This has, of course, completely killed much of the underwood and flowering plants, and has even singed the bark of small trees, not, probably, to the extent of killing them, but very likely to that of stunting and retarding their growth. From my experience in groves and forests of my own, which leaf fires accidentally ran through in my absence, I should be very sorry to allow fire in any woods of mine again. This was on light soil over heavy clay. High Park is light soil above light soil, in the part in question. The result in my case was that the forest never thrived after, and in a few years had to be cleared, many of the trees having died. What may be the result of this heroic treatment in the park, I cannot say, but I should fear it very likely to be injurious. From my point of view, the loss of the underwood is a deep injury to the park, and only too likely to be fatal ultimately to the trees. It is again from my point of view, a very great injury to the city. The city had, through great private munificence, the benefit of a wild and beautiful wood, of large extent, where still flourished in boundless profusion, the shrubs and wild-flowers once common in Ontario, now common no more. Either by accidental fires, or by such work as the present, most of the underwood has long disappeared; but yet, last summer, a vast wealth remained. Of this, the last spring's unwise destruction has obliterated much, and its present managers, I should think, by the system of forestry—or rather anti-forestry—they appear to favour, will soon obliterate all.

Add to this that the grove of Grenadier Pond has been cut down. The Grand Trunk Railway Company have emulated the work by felling the row of trees which formerly fringed the bay. I believe there are some people whose bitterness of heart leads them to say "What a pretty tree ; it may be pleasing to some one ; let us haste to destroy it."

The treatment of the trees themselves also claims a word. A very great number have had all their lower branches cut off to a considerable height. It is only necessary, to any one who knows theoretically or practically, anything of forestry, to say that this has been done with both evergreens and deciduous trees, and that most of them are not in closely growing groves, but rather openly situated, to indicate the result. Evergreen trees should not be pruned ; their branches' growth should be checked, if desired, when young by pinching off the terminating shoot. This itself, in open situations, is not desirable, as the tree needs its lower branches to preserve the ground beneath in condition to nourish its growth. It is the natural habit of the tree. But to cut off a number of large branches from an evergreen, as has been done here, is to render the tree, as the gum will continually exude, a disgusting object. It would in my opinion, in open places, as contrary to the natural habit, greatly weaken or eventually kill the tree. I append notes from our best authorities on this. All the fine evergreens (pines) close to the Grenadier Pond have been so treated, and many throughout the park. One, a once beautiful red pine, close to the road, shows already what will be the result. Its lower branches, seven in number, have been amputated, not even closely, and the poor object stands by the wayside, apparently holding up its bleeding stumps in testimony against its persecutors. I do not know, but it appears to me that the plan contemplates doing this with all. I would add one point concerning this treatment, applicable to both evergreens and deciduous trees, many of which latter have been so pruned as well. Trees grown in the open need the protection of their lower branches ; they keep the ground in better condition (mulching it), and the bark has grown under the protection of the branches. To lop them, especially many trees at once, deprives it of this. To thin out trees and then lop the lower branches of those remaining is to intensify this injury. For instance, all of us who have cleared forests know that the line of forest trees left exposed—the outer line—weakens and falls. Where conditions are favorable, nature will endeavor to protect them, by growing a line of trees at the edge which will branch to the ground. These will not die in the open—they are grown in it and for it, and they teach us a lesson.

As for roads, carriage roads were being cut unnecessarily. There were enough before ; the fewer the better ; they raise the dust. But they were cutting them along the few wooded slopes left—cutting down a straight bank above, which will wash away from, divide, and kill the trees above, casting the earth into the wooded slope below, which will kill the trees about which the sand will pile itself. A little while, and the road will be bordered by sickly trees, instead of the fresh, bright grove which should have been.

As to the open grass land. This is going to ruin. The soil is very light, and areas of blowing sand are being allowed to form, which are spreading and will spread. There are some of them hundreds of feet across. Is it possible that the people in charge do not know how to check this ?

In fine. With an area of poor soil, such as High Park, to have a forest, in my opinion, we must have an undergrowth. This is being destroyed. To have a pleasing forest we must have the natural ravines, wooded as they were. They were being cleared up, and, in my opinion, rendered worthless for their proper use. To retain vegetation on such a soil, in my opinion you must not thin it, but thicken it. The opposite of this being done; it was being thinned and thinned to purpose. If you attempt, as was being attempted, to make High Park a grass-covered space with sparse-scattered and tall-stemmed trees, you will, in my opinion, kill or greatly weaken all that is there, and you will neither have ultimately trees fit to be called such, nor grass worthy the name of grass; you will wade ankle-deep through loose sand before long, and then some speculator will represent to you that this wide waste were better sold off in building lots, and he will be right.

The following are the notes on evergreen pruning:—

Pruning frondose or resinous trees is one of the greatest errors in forest management. The pine and fir tribe should scarcely be pruned at all.—Loudon.

The pruning of the pine and fir tribe can be productive of no possible good.—Cruickshank.

The amputation of healthy limbs from trees of the pine, birch, fir and cedar to any considerable extent, is highly injurious from the wounds bleeding for years after they have been made, and thus causing a great loss of the sap. A live branch removed from a young oak or elm bleeds little, and the wound soon heals, but if one be removed from the stem of a pine it continues to bleed for a very long time.—Brown.

It is but right to say that a change is yet possible. Instead of a drying wood we might have magnificent trees, and many and close; instead of blowing sand a rich and velvety sward, instead of burned leaves and scattered grass tufts a rich and graceful underwood. It is not, I fear, to be. But our rising towns throughout Canada, before the forest is quite gone from around them, might well secure portions of it for parks, and and may be assisted in some respect in their preservation by the knowledge of the mistakes unfortunately made here.

PRUNING FOREST TREES.

There is nothing in which greater carelessness or want of knowledge is manifested, in this country, than in the pruning of trees. People are in the habit of thinking that if they have to cut off a limb from a tree, it will injure the tree less if a length of from three to twelve inches be left on the trunk—a snag, in fact. This is one of the greatest errors in forestry. The snag left, far from protecting the tree, injures it in two ways. It rots, and the rotting extends to the heart of the tree, and even at last to the root, decay finding its way down the trunk. Next, the wound cannot heal, for the bark cannot grow over the snag. This is so well explained in an article of Mr. Burrows, of Kent, England, appearing in *Woods and Forests*, a periodical published some years ago in London, but now, it is to be regretted, discontinued, that I have given his statement in

full as below. When in London, I called on the gentleman who had been the proprietor of the journal, and he obligingly furnished me with the back numbers of the paper from its commencement to its discontinuance, with the view of assisting forestry here. This is the principal use I have been able to make of them this year, but other articles may be of service in future. This article, if carefully read, will give, what is much needed, a full idea of the reason and absolute necessity of close cutting when pruning is necessary. In connection with this, I would direct attention to Mr. Macgregor's evidence regarding conifer pruning in another page, and to the article on parks :—

Sure indications of an increased and increasing attention to the growth and management of timber trees are offered by the anxiety which is now manifested respecting proper methods of thinning and pruning them. At the close of the last and the commencement of the present century, great complaint was made about the large quantities of defective Oak timber which was admitted into our dockyards and afterwards rejected as being unfit for use. The demand for Oak timber had for many years been great, and the purveyors found their choice of trees more restricted year after year. The supplies from public and private sources failed to keep pace with the demand. An opinion sprung up that the cause of the evil was the neglect of pruning, and that the rotten branches dying back upon the trunks carried decay to the very hearts of the trees. Many owners of Oak plantations at once commenced a system of pruning which was little better than an indiscriminate lopping of branches; but fearing that too close an application of the saw would permanently injure the trunk, they cut off branches at distances of 1 foot, 2 feet, and even 3 feet from it, leaving the stumps to die back, and in some cases intending to cut them off closer at the time of a second pruning. This system of snag-pruning was soon found not to answer, for a rapid decay of the stump frequently increased the evil which it was meant to cure, and produced rottenness where distortion of the grain would have been the sole evil. The stumps upon which living spray was left, or from which it afterwards sprang out, continued to live on, but they produced irregularities of growth which were almost as objectionable as the dead knots of the decaying branches. An improved method of pruning, properly called foreshortening, first employed by Mr. Billington in the Forest of Dean, was afterwards successfully applied to the hedgerow timber upon the Holkam estate, in Norfolk, by Mr. Blaikie, then the land steward there.

With timely attention no tree should require much pruning after the age of twenty years, and few branches should be cut off after they have attained a diameter of more than 2 inches or 3 inches, and consequently have formed red, or heartwood. But from the results of early neglect, from accidents by winds and other causes, from a desire to open out and extend views, to mitigate the effects of shade, or to improve the form of trees, injured branches frequently require to be removed, and wide-spreading ones of large size to be cut back. From a neglect of timely pruning also arises wind-shake in all its forms. Whenever the head of a tree is very unevenly balanced, heavy gusts of wind produce oscillation, resulting in longitudinal rents from the top to nearly the bottom of the trunk, and extending from the pith to the bark. In a similar way is produced cup-shake, by which the inner layers of alburnum are separated from the outer, the whole forming a series of tubes which drop apart when the trunk is cut up.

The annexed woodcuts afford illustrations of both the old or snag method of pruning, and the new or close method:—

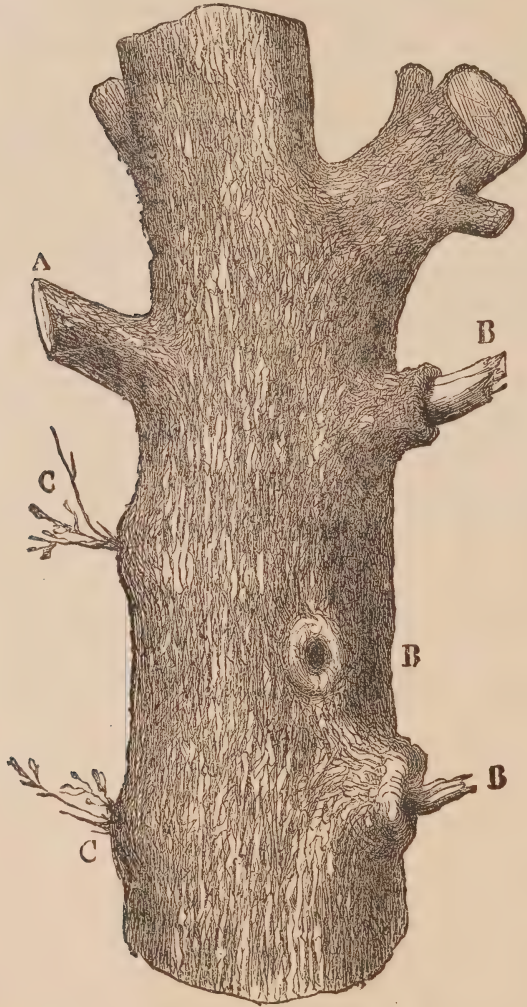


Fig. 1.—An example of a badly pruned tree.

Fig. 1 represents the condition of an Oak tree in the twelfth year after pruning. A is a branch only recently cut off at a distance of 9 inches or 10 inches from the trunk; BBB are the stumps of branches which were cut off in a similar manner at the time of the original pruning, and which have now arrived at the stage when they communicate their own rottenness to the organs of the body of the tree; CC are knots, which, though now covered, are producing defects in the timber from the circumstance

of their having been cut away 2 inches or 3 inches from the body of the tree. These are the remains of branches of a large size, and the knots continue the disorder in the tree by maintaining the deviation of the tissues and woody fibre.



Fig. 2.—Showing a branch cut off at too great a distance from the trunk.

Fig. 2 represents a branch of large size recently cut off about 8 inches from the trunk, and the surface of which is already splitting from the combined action of the sun and atmosphere, thus admitting moisture which will rapidly make its way to the heart of the tree. From its having been cut off at so great a distance from the trunk after the bark had become considerably indurated, perfect healing is impossible.



Fig. 3.—The same branch as in Fig. 2, the fourth year after amputation.

Fig. 3 shews the same stump in the fourth year, when decomposition has made considerable progress, because the bark upon the edges of the cicatrice has not been able

to fix itself upon and to overlap the stump. In consequence of this, the bark itself is falling back from and exposing the wound.

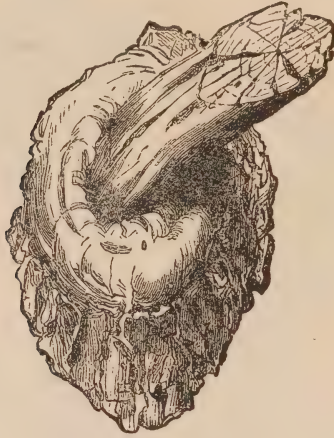


Fig. 4.—The same branch as represented in Fig. 2, the sixth year after amputation.

Fig. 4 represents the same stump in the sixth year after amputation, when decomposition has made still greater progress, and all hopes of arresting it must be abandoned.



Fig. 5.—The same branch as shown in Fig. 2, the eleventh year after amputation.

Fig. 5 shews its state in the eleventh year, when the rot has formed a gutter, which is extending deeply into the woody tissues, and in which is to be found a considerable quantity of red and fetid water. The stump, being cut obliquely, with its face upwards, takes in water like a sponge, and retains it as in a reservoir. The incessant action of the water renders it impossible to arrest decay, which is consequently rapid.

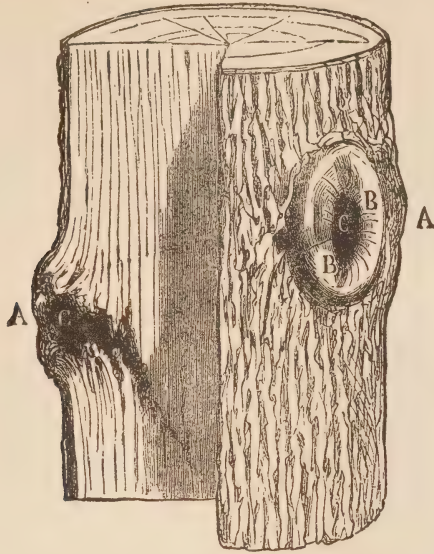


Fig. 6.—Another example of bad pruning.

Fig. 6 is a section of an Oak fifty years old, the branches of which have been cut off at distances of from 8 inches to 12 inches from the trunk, and have since become destroyed by atmospheric influences. AA show the surfaces of the stumps; BB the lips of the cicatrice, which, in the efforts to approach each other, meet with nothing but decomposed and rotten tissues, instead of sound and solid wood, upon which they could fix themselves; consequently they will never unite or cover the wound. CC are rotten masses caused by the decomposition of the woody fibre of the stump, and by the ravages of insects; they stretch deeply into the body of the tree, and will in time extend to the very bottom of the trunk.



Fig. 7.—Example of the best method, showing a wound the second year after pruning.

Fig. 7 affords an illustration of the newer and more scientific method of pruning, in the second year after the operation has been performed. A fair-sized branch has been removed from an Oak tree from forty to fifty years old. From the cut having been made

near the body of the tree, and close to the ringswell, or protuberance of bark and wood which surrounds the base of the branch, natural healing is already far advanced. The surface of the wound is sound and free from all the elements of destruction, which is partly the consequence of its having been dressed at the time of cutting. Whenever a branch of considerable size is cut off near the trunk, the process of healing over is very much facilitated by an application of grafting-clay in a moist state, as wounds from the saw, the pruning chisel, from wheels, or from other causes are healed over much more rapidly when light and air are excluded. Dressings of various kinds, such as hot tar, grafting-wax, etc., have been tried and recommended, but none of them surpass in utility the common clay.



Fig. 8.—Shewing a well-pruned Oak the tenth year after the operation, with the scar quite healed.

Fig. 8 represents a section of an Oak tree from sixty to eighty years old, in the tenth year after pruning, and upon which perfect healing has taken place, leaving only a slight longitudinal crevice where the lips meet, but which does not extend into the wood. Upon the superincumbent layers of wood when cut up there would appear but a feeble deviation of the fibres. This would be so small as not to interfere with the strength and plianthood of the timber or cause harm to any part of the woody tissue. Upon recovering from such a wound the tissues could resume their natural and regular direction, the surface of amputation acquiring each year new layers of the white substance between the bark and the wood. After this follows perfect or sound wood, and even the lips of the wound unite and become sound, having retaken the qualities, and almost the appearance, of the original bark, of which it now performs all the usual functions of protection and vitality.

TREES TO PLANT.

It is not so difficult to raise timber as many people imagine. The lack of correct information on this subject is, I believe, to a great extent the reason why so little timber is planted. If farmers only knew how to plant, and when and where, they would not be so slow to raise trees. As previous reports have given full directions concerning choice and planting of trees of all kinds, I will now only state some particulars about one or two valuable varieties, on which we have received fresh information from Gen. Brisbin's just published and valuable work on forestry. His ideas are given as follows :—

THE ASH.

This is one of the best trees for forest-culture. It grows rapidly, is easily raised, and of great money value. Mr. Hollenbeck, of Nebraska, has in Douglas county, a piece of ash timber he planted in 1861, and many of the trees now measure thirty-eight inches in circumference, and are over forty feet high. Mr. Budd, of Iowa, has a grove that has done better still. He says ten acres, thinned to six feet apart, contain twelve thousand trees, and at twelve years of age were eight inches in diameter and thirty-five feet high. The wood from thinning paid all expenses of planting and cultivation. The bodies of the trees cut out sold for forty cents each, and the tops were worth ten cents more. Ten acres of this timber, twelve years old, was estimated to be worth six thousand dollars. Young ash if cut low at eight years of age, and a light furrow turned over the stumps, will sprout and be ready for a second cutting in eight years. Mr. Budd says ten acres of black ash, planted for hoop-poles, in rows four feet apart, may be half thinned in five years, and at three cents per pole will yield \$1,620. The remaining half or fifty four thousand poles, cut two years later for large hoop-poles, at six cents per pole will yield \$4,860. The ash seed should be sown in the fall, in rows two feet apart, and covered with one inch of earth. In winter scatter a litter of straw three inches deep over the ground. The straw should be renewed early in the spring. The plants will grow as soon as the frost is gone, and will be twelve to fourteen inches high by fall. This will make an admirable nursery, from which the trees should be transplanted when one year old and set out in the forest ground, four feet apart. Work the ground the same as for corn, and keep the weeds down; the closer the trees are planted the straighter they will grow, and be free from lower limbs.

THE WHITE ASH.

The ashes greatly resemble each other in their quality of wood, but for profit and cultivation the white and blue ashes undoubtedly lead. Most of the farm utensils manufactured in this country are partially constructed of ash, and on this account are greatly preferred by the British farmer to those manufactured in his own country; this is owing to the excellence of the ash used in their construction. Owing to the rapid consumption of ash, not only for farming utensils, but for any purpose where toughness and durability are wanted, there is not the slightest doubt that the ash will be one of the most profitable trees to plant.

The white ash is one of our largest trees, when it has attained its full growth. It is usually from two to three feet in diameter, with a straight trunk, free from branches to the height of thirty to forty feet. We find the white ash in the New England States, New York, in the Northern States, and in the Dominion of Canada, but it is fast becoming scarce. It is common, but not by any means abundant in Northern Illinois and Iowa, but is unfrequent southward. It also grows to a small extent in Southern Kansas, but is so small and crooked that it is worthless, except for fuel.

The white ash needs a moist, cool, deep soil, and will not thrive to any extent in poor, dry land. Those trees of the ash family that have been of the most rapid growth afford the best timber, while that from slow-growing, stunted trees is generally weak and brittle.

Ash is very extensively used in constructing carriages, furniture, and agricultural implements ; it also makes very good firewood. The supply is fast diminishing, and its use increasing, and those who propose to take advantage of this cannot be too soon in planting and getting ready to help fill the demand. The American ashes are dioecious, *i. e.*, the fertile and the barren flowers are on different trees. Seed is only produced by white ash trees that are growing in open ground. It bears transplanting well, even when partially grown. It is a handsome and ornamental tree, and the only insect that attacks it is the May bug, which devours the leaves early in the summer. The seed is ripe early in October, and falls with the first frost.

THE BLACK ASH.

The black ash has the same characteristics as others of the ash family. Its chief use is in the manufacture of barrels, baskets, and hoops for barrels, but it is less durable than others of its species when exposed to the weather. When green, it can scarcely be burned, but when seasoned is very good fuel. A great deal of alkali can be obtained from its ashes. It can be raised on ground that is too wet to produce other valuable kinds of timber. It is to be planted the same as others of its species.

EUROPEAN LARCH.

This tree rises to the height of from ninety to one hundred feet, and in general contour much resembles the black larch. It is found in the Alps of France and Switzerland, of the Tyrol, and in the Carpathian Mountains, and in various mountainous districts of Europe. Thanks to the assiduous care of the Duke of Athol, it has been planted in England as a forest tree, and duly recognized as one of much excellence, both as an ornamental and a timber tree. It is very durable, and adapted to a variety of uses, and is daily growing in greater demand.

Loudon says, "The rate of growth of the larch, in the climate of London, is from twenty to twenty-five feet in ten years, from the seed, and nearly as great on the declivities of hills and mountains in the Highlands of Scotland. A larch cut down near Dunkeld, after it had been sixty years planted, was one hundred and ten feet high, and contained one hundred and sixty cubic feet of timber. In a suitable situation, the timber is said to come to perfection in forty years, while that of the pinaster requires sixty years, and that of the Scotch pine eighty years."

W. C. Bryant, in his excellent work on trees, says, "The larch, planted four feet apart each way, may in ten years be large enough for fence posts. At that distance, about twenty-seven hundred would grow on an acre." A great deal of foreign testimony may be cited in regard to the durability of this tree, as, for instance, tried by driving a post made of it alongside an oaken post in the Thames River, where the tide rose and wet it, and then subsided, and left it exposed to the drying influence of the sun. The oak posts were renewed twice before any alteration was noticed in the larch. The vine props of a great many German vineyards are made of this timber, and have been handed down from generation to generation, and will still be handed down in an almost perfect state of preservation. M. Brissel de Monville says that he has examined trees in the forests of Switzerland that have been struck by lightning and badly shattered, and yet the heart wood is still perfectly sound, and the uninjured limbs continue to grow in a perfectly healthy condition ; and even trees that had lain on the ground for years, and become thoroughly dried out, have not rotted, but have become brittle with old age, and may still be scaled off. It is the best timber for rails, fences, etc., and anything that requires to withstand the weather. The larch appears to grow best on uplands, and I doubt not, with a little care and attention, some of our own hills and prairies could be covered with a luxuriant growth of larches. It does not seem to thrive on low, damp plains, and I would not recommend anyone to try it in such places, as a failure might prejudice them against a tree that is destined to become one of our most useful and ornamental trees. Great care should be taken in the purchase and selection of seed, to obtain it from

thoroughly reliable parties, as large quantities of worthless old stuff are sold for good seed, that no one could make grow. I would recommend seed from the Tyrol in Switzerland, or from the Valais of Switzerland, both of which are usually purchased by the horticulturists of France, Germany and Scotland.

In closing these remarks about the European larch, I would call attention to the experience of Mr. Thomas Lake, a resident of Winnebago County, Illinois. In a recent letter Mr. Lake says, "A few years since I saw in the *Rural New Yorker* the European larch advertised for sale by Robert Douglas & Sons., Waukegan, Illinois, and being well acquainted with the fast growth and value of those trees in my native home, England, I bought and planted nine thousand, and have to regret that I did not multiply that number by ten at that time. They were quite small when I bought them—many not larger than a lead pencil, and not over a foot high. My ignorance as to how this climate would suit them was the only reason I did not venture to plant more at that time. Many of those trees are now standing thirty feet high, and six to seven inches through at base, as straight as an arrow, and much admired by those who see them. My mode is to plough the ground deep—the deeper the better—and make it as mellow as possible. I do not advocate deep planting. I mark out, with the plow, furrows four feet apart each way. As I plant I settle the fine earth firmly around the roots with my foot. Get the ground ready as early in the spring as possible for your trees, as the English larch is about the first tree that starts. At corn-planting time, I planted two grains or more of corn on the south side of each little tree; if more than two grew, I pulled them up. The corn-stalks acted as a shade for the young trees, through the heat and drought of summer, and I think it saved many, as the season was extremely dry. Many think that when they have planted their work is ended, but it is just begun, if one is resolved to succeed. I kept the young larches well cultivated with the corn cultivator, not allowing any weeds or grass to grow. I harvested corn enough to pay for the labor, and produced the largest ears grown on the farm. The reason of this was that there were only two stalks to the hill, and they were well and often tended. I followed the same course the next season, and intended to do so the third, but in this I was prevented, as the trees had grown so fast that I could not get the horse and cultivator through without injuring them. That season they covered the ground, and choked out the grass and weeds. So ended my labor."

SUGAR MAPLE.

Mr. Pinney, an experienced tree-grower, says, an acre of sugar maples at twenty-five years of age, will average one foot in diameter and produce two thousand pounds of sugar annually. When the trees measure twenty inches they will give sixty thousand feet of lumber, worth \$2,500, besides a great deal of fuel. A peculiarity of this tree is, its body increases faster in size than its top. It can, therefore, be planted very closely. Two hundred trees will grow on an acre. Maple seed ripens in October, and should be planted in rows, the same as ash, but not so thickly. After planting, allow the tree to stand two years in the nursery, and then transplant to ground where it is to grow permanently. Old sugar orchards, with trees left scattering and thin, usually pay a good interest on the value of the land. Two or three hundred maples will thus usually occupy as many acres, often interspersed with beech, basswood, or hickory. The labour of gathering the sap over a large area is much increased, while the production of sugar is diminished. I do not know that any one has practically tested the plan, but it seems to me that a regularly planted sugar-maple grove, on good land, but not too high-priced, ought to pay, at least as well as the average of farming operations. Many farms are already scarce of wood, and to grow two or three acres of sugar-maple orchard would kill two birds with one stone. To accomplish a third object, the sugar bush ought to be planted in such shape and position as to protect the farm from the prevalent destructive winter winds. A grove of trees on the west side of every grain farm would often be worth the use of the land, simply as a shelter-belt to protect winter grain. As forests are being cleared off many farmers are learning, for the first time, the importance and necessity of these shelter belts of trees, to protect their crops. But to the plan. For convenience in sap-gathering, the sugar orchard should be planted in as compact a form

as possible, and in regular rows, ten feet apart each way. This will give, if there are no vacancies, four hundred and thirty trees per acre. But, when young, the trees will grow better if planted closer, say in rows five feet apart, and cultivated for two or three years. Once or twice scarifying the surface during the summer to destroy weeds, will answer, if you can get two or three year old trees to start with. Often trees ten or fifteen feet high, from new growth woods, can be bought at small cost, and when this is possible it is always preferable. A young tree, taken from a dense growth in the woods, where it has been stunted and smothered, will grow more rapidly when planted where it can have room to spread, if it is well cultivated and pruned. These unpruned masses of young trees in a forest, each choking the other, and neither half living, are the bug-bear which deters hundreds from planting trees. Farmers see how small a growth these make, and conclude that forest growing is a very slow and unprofitable business. Yet when these same trees are planted by the road-side, often foot-bound with grass, their growth is much more rapid. I have, in my mind, a row of noble maples, planted seventeen years ago this spring by a public road, which have, for two or three years been large enough to tap. They were got from the woods, and were the size of whip-stalks when planted. Young trees of equal size when left in the woods uncared for are not half their size. Yet these trees have stood in grass most of the time since planted. Cultivated in orchards, with room enough to grow, and yet so close as to keep down the grass, their growth would probably have been larger than it is. The principal objection to the maple for timber is the facility with which it decays when exposed to the weather. For fuel, the sugar maple is the American tree *par excellence*, not second to the hickory, which is claimed by many eastern people to be superior to all others for heat-producing qualities. It forms a dense, broad-based, round-topped, frequently egg-shaped head of deep green foliage, clean, and more free from insects of all kinds than any other deciduous tree we know. It justly claims a place at the head of American ornamental trees. Being hardy, it is easily transplanted in large sizes, and bears cutting back very patiently. We have known of large trees, three to four inches in diameter, with the tops all cut off, being moved from Northern Wisconsin to the prairies of Illinois, and being successfully transplanted. This tree is by far the most valuable of its species; its wood is hard, heavy, strong, close and fine grained; has a silky lustre when polished. The curled maple and bird's-eye maple are the same as the sugar maple, the curl or bird's-eye being caused by the undulations and inflections of the fibre. Its chief uses are in the manufacture of cabinet work, gearings of mills and in naval architecture.

Sugar made from the maple commands a much higher price than that made from the sugar cane. The syrup made from maple commands a much higher price than that made from sugar cane. The syrup made from maple sap is ranked among syrups as A. No. 1.

The seeds are in pairs, and are united at the base, but only one of each pair is of any account, the other being worthless. The trees never produce seed two years in succession.

The sugar maple will not thrive in poor, sandy soil, but requires almost any good tillage land. It will not live where the soil is saturated with water during the growing season. Bryant speaks of losing a number of sugar maples in the wet season of 1874, which had been growing several years upon land which in an ordinary season was dry enough for cultivation. It continues to grow after the silver maple has arrived at maturity, so that a tree-grower should not be discouraged at its slow growth in its early stages. The black sugar maple, though formerly classed as a different tree from the sugar maple, is now generally considered as a variety of sugar maple. Its general properties and its sap are the same; its general appearance is darker, and its leaves are larger, darker, and less scalloped than the sugar maple.

THE WHITE PINE.

This is one of the best-known of our American trees, and reaches a height of from one hundred and eighty feet, with a diameter of from two and a half to six feet. So much of our pine has been cut and shipped to the old world that, where the pine was

formerly abundant, as in New England, Northern New York, and Pennsylvania, it has now become scarce, and large tracts that were thought to be inexhaustible, are now bare and devoid of pine. The North-western States at present furnish nearly all of our pine, but it is needless to expect even here a renewal of the pine, for the tide of immigration is so great that, before a second supply will have time to grow, the country will be populated, and instead of pine-forest we will have comfortable farms and cities. The white pine is a hardy tree, and accommodates itself to almost every variety of soil. The wood of the white pine that is grown on dry uplands is harder, more resinous, stronger, and has a much coarser grain than that in moister soils. It is a very graceful tree, its foliage being soft, its color a deep, rich green, the only objection to it as an ornamental tree being the formal arrangement of its branches in whorls, but this is lost sight of in a large tree. Its wood burns freely, but does not give much heat, hence it is not fit for much until it has reached a convenient size for hewing into timber or for lumber. Hence I would suggest that in planting, the young trees they be set eight feet apart, and the intervening spaces be filled with trees of easier propagation, which may be cut out and used before the pines become crowded. Great care should be taken to preserve the leading shoots of the young pines, as they are very tender and apt to be broken by the intervening branches.

THE HICKORY.

The shell-bark is the best for planting, either for wood or for fruit. If planted for nuts, it should be kept in the nursery until two or three years old, and then transplanted. To make it bear early, dig under and cut the tap-root, as close to the surface as possible. For timber, and rapid growth in transplanting, dig the holes deep, and see that the tap-root is put in perfectly straight. The nuts should be dropped four feet apart each way, and, if planted in ground where the trees are to remain, the plants should be thinned so as to keep the branches from touching. Hickories are rather slow of growth, so I would advise that it be transplanted after the first year, to the place it is to occupy permanently. A nursery of young trees should be carefully weeded and cultivated until they have arrived at such height as to render them safe from the encroachment of weeds.

It has been found that those trees that have been transplanted bear the best fruit, while those that have not make the best timber. This tree merits cultivation more than any tree of its species, both for fuel, timber, and its fruit, which, to my taste is much superior to the walnut.

ADVICE ON VARIOUS TREES.

As for planting trees, for which full directions have been respectively given in former reports, it may be said again that all trees will grow well on fairly-good drained land, the soft maple bearing the moist land better than the hard maple, as does the alder, the cedar and some others. The pine variety will grow on poor sand, but better on a loam. But there are few soils on which, if well softened by ploughing and the ground planted so closely as soon to shade itself, trees would not grow. Most farmers in the country would be the better for a few acres got into good tilth and planted with valuable descriptions of trees on the side which needs shelter most in their locality. I append a statement from one of our best and oldest tree-planters in Ontario (Mr. Leslie), which appeared in another publication some years ago, but which for practical and reliable knowledge is unequalled :—

We consider the Norway spruce the most valuable tree there is for planting in shelter belts ; it is extremely hardy, very rapid in growth, and easily transplanted. We have found the white spruce, a native of this country, a most excellent tree for shelter belts ; but it is not so rapid a grower as the Norway, and for that reason the latter is superior. We have a black spruce, but it is not a good variety, as it is apt to become poor at the bottom, that is, in the early stages of the growth of the tree the lower limbs decay and are lost, while the white spruce and the Norway hold their foliage to the ground. When I speak

of shelter, I mean shelter for farm buildings, orchards, etc. I would consider these spruce valuable to plant in shelter belts or farmers' fields, they would certainly assist in gathering the snow in winter time, and thus help to protect the fall wheat. Trees for this purpose would not require to be of great height. If farmers consulted their own interest, I think they would commence by planting out small stock, say from twelve to eighteen inches high. These trees grow very rapidly, say on an average three feet every year for the first five years, gradually lessening thereafter, and in a short time the farmer obtains a good shelter. As we get these trees from the old country they are two years in the seed-bed and two years transplanted. That brings them from twelve to fifteen inches in height and nicely rooted. When received in good condition we do not lose one cent in transplanting them. If in poor condition, they are transplanted before being sold, and get a couple of years in this country, and are then removed. The tree is thus, in the latter case, six years old from the seed when planted for the purpose of shelter. Sometimes they come in bad condition, from having been stowed away in warm places in the ship, and in this way numbers are apt to be destroyed. I would rather have them come in winter when they are frozen solid. A tree will stand a great deal more frost than any people have any idea of without injury, provided it is allowed to thaw out naturally. The best lot of spruces we ever had from the old country came to us frozen solid. They are generally packed in dry moss, but accumulate a little moisture and freeze. In planting a shelter belt, say an acre deep, the trees would not require to be placed closer than six feet apart; at that distance they would interlock in a few years. At six feet apart, about 1,200 trees per acre would be required, and they would be planted very cheaply by running furrows with a plough lengthwise and then across, placing the trees at the intersections of the furrows. This would give the trees sufficient depth; in fact, I would rather earth up a little than plant too deep. I consider a good shelter belt can be made with evergreens two deep, placed say ten feet apart, with a distance between the rows of five feet, and the trees placed so as to break the spaces of the rows. A shelter belt made in this way on the north side of a square ten acre field would require 130 trees, and for the north and west sides double that number. My advice would be, unless the ground is in extraordinarily good condition, to take the young trees as they are received from the nursery and make nursery rows of them, give them a little care until they arrive at the height of eighteen inches or two feet, and then put them into permanent position. These would require from two to three years to grow to this height, and would then be a good size to transplant. After that, their ordinary growth is two to three feet per year in good soil, and fully two feet in any soil, so that in six or seven years the farmer would have a good shelter. I prefer the Norway spruce wholly to deciduous trees and evergreens mixed, as in the latter case the one kind checks the growth of the other. If a row of deciduous trees were planted inside a belt of evergreens, the latter would be spoiled; but there could be no objection to planting a row of maple or Lombardy poplar very close to the fence line for the purpose of being cut down after the spruces had attained a proper size, and for shelter until that time. The deciduous trees do not protect the wheat in the winter (when protection is most needed) so well as evergreens. I imagine the white Canadian spruce would be cheaper in many localities than the Norway variety; the trees could be taken from the woods and planted as in the nursery. There is no difficulty whatever in transplanting these trees from the woods when young; it is simply a matter of keeping the roots moist while out of the ground. I would recommend that they should always be planted in nursery rows before being permanently placed in position, and if they have ugly tap roots, these should be cut off. I would not recommend that the tops should be cut; there is no necessity for doing so, and it destroys the symmetry of the tree. There is no necessity for cutting the tops of deciduous tree seedlings. It is not necessary to cultivate or manure the Norway spruce in any way; it will grow on stiff land, on dry sandy soil, or on soil of any kind. If evergreens are manured, it must be very slightly; a little ashes will agree with them.

I do not approve of our Canadian tamarack at all. The timber is poor, and if people desire to go to expense of planting for timber, I would recommend them to plant the European larch—which is a splendid tree, a rapid grower and will grow in any part

of this country. It is not an evergreen, but it throws out a great number of small branches which are a great protection. It is a very rapid growing tree, even more rapid than the Norway spruce, growing more than four feet on an average every year, unless the ground is very poor, in which case, of course, the growth will be less. In five or six years the tree will be twenty-five or thirty feet high. I would plant larches three or four deep. I do not think it a good plan to mingle larches with Norway spruces; I would plant all larch, all Norway spruces, or all cedar.

Some people like the Lombardy poplar and some do not. It does not harbour insects, on the contrary, it is a very clean tree, but in this climate it is apt to die and become ragged at the top. In the latter case, however, if cut every few years, it will grow more handsome with each cutting. It is being largely used for shelter purposes. The Northern Railway have ordered some thousands, and are putting them up along the line instead of fence posts, and using barb wire to form the fencing. The wounding of the tree does not do it any harm. On the prairies of the West, they are used, too, to a great extent, without the barb wire. The trees are planted six feet apart, and when they have attained a sufficient height the top is cut off and nailed laterally from tree to tree as a barrier. By the time the top thus placed has decayed, a new one will have been formed on the tree. I think the height at which poplars for such purposes should be planted is immaterial; it is merely a matter of expense, as the tree has undoubtedly great vitality. They seem to grow as well if planted when they are as large as your arm, as they do when they are the size of your little finger. In seven or eight years it becomes a tree of thirty feet at least. Our balsam poplar is not a very handsome tree, but it makes a good shelter. In localities where you do not want to cultivate anything, it can hardly be recommended for ornamental purposes. The sycamore is a little tender north of Toronto, and the tulip tree is also tender. Some willows are very pretty, the crimson bark willow, a variety of the golden willow, from which it differs in having the shoots crimson, is a reasonably fast-growing tree; the golden variety is a fast growing and very long-lived tree. The alder is a rapid growing tree, suited to low lands, and attains large dimensions. Its economic uses are various, but it is chiefly valued for tanning and charcoal purposes. The willow makes the finest charcoal for the use of artists. All these trees that I have mentioned are suited to the climate of Ontario generally, and can be depended upon.

All these trees are found in all nursery lists. Quite a few of them are indigenous, and, therefore, adapted to our climate. I do not think the capacity of a tree to resist our climate at all depends upon the place in which it has been raised. Trees that are hardy, though raised in a warm climate, will, if brought to Canada, be just as able to resist our climate as our native trees; a hardy tree will be hardy no matter where you attempt to grow it. I never noticed any hardening process going on before transplanting. Trees purchased from us thrive in any part of the Province, if naturally adapted to it.

For tree planting on waste lands, or hillsides, with an economical view, I would recommend the English ash as a most useful tree. I think it would come into the market earlier than any other tree that could be planted. It is largely used for handle-making, and about ten years growth on ordinary soil would produce a tree that could be split into four pieces, each of sufficient size to make a handle. The English ash is not the same as our common black ash; there is as much difference as between the European larch and our tamarack. It is a more rapid grower than the black ash, and the wood is better in every way. The American elm, and the European larch, would also be suitable for this purpose. The latter makes the best railway ties of any wood in the world, as it is almost indestructible; it is a very rapid grower, and in ten or twelve years' time the wood is of merchantable proportions and useful for many purposes. Of course, it would not be fit for railway ties by that time, but suitable for manufacturing purposes. It would be decidedly profitable to railway companies, as well as beneficial to the country, if the waste lands connected with their lines were planted with European larch. From this source they could in time obtain an almost inexhaustible supply of railway ties much superior to the kind now in general use. Another use to which the European larch can be put is the production of "ships' knees," as it

can be trained when young to the desired bend. It is suited to our climate, being perfectly hardy, and very easy to transplant in the spring. It requires early transplanting, though later in the season it will thrive if transplanted, provided the roots are kept moist. As a rule, however, it should be planted as soon as the frost is out of the ground, or as late in the fall as possible before the permanent freezing of the ground. They could be imported at about the same price as the Norway spruce. I would not recommend planting them after they attain a height of more than eighteen inches or two feet; they are a little impatient of being moved after that time. There is not a large supply of them kept in this country. If very large quantities were required, as for instance if railway companies should go into their cultivation, they would have to be imported to meet the demand.

The silver-leaved maple affords excellent wood and is a fast growing tree. This tree is grown in Canada. We grow them largely. There is not a very great demand for them except for shelter and ornamental purposes. The wood is soft, smooth, of a long grain, and is very useful. In my opinion the Norway maple is the finest of all maples. The wood is as hard as a bone, and ought to be useful for many purposes. I think it ought to take the place of boxwood for many purposes for which that wood is now used by engravers, as the grain is very close and hard. The sugar maple is also a useful tree in many ways.

In the nut trees, the black walnut grows very rapidly in its younger stages—almost as rapidly as the English ash. I think the black walnut would have to be confined chiefly to the front of the Province. I never saw it east of Cornwall, but the south-west portion of the peninsula is its home.

Other Trees.—The American sweet chestnut is not quite so hardy as the black walnut; it would have to be grown further south, and requires a warm, sandy, poor soil. The butternut is a very fine tree, and a quick grower, a little more rapid in its growth than the black walnut, and is useful in many ways. It makes capital wood for veneering. The hickory is hardy as far north as Peterborough, but is a slow grower, though it can be used for many purposes when three-quarters of an inch or an inch in diameter.

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Ontario. Forester, Bureau
Annual Report.

FORESTRY REPORT.

1889-90.

COMPILED AT THE INSTANCE OF THE GOVERNMENT OF ONTARIO.

BY

R. W. PHIPPS,

TORONTO.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.



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1891.

To the HON. JOHN DRYDEN,

Minister of Agriculture, Ontario :

SIR,—I have the honour to forward the Forestry Report for 1889-90, being the sixth issued, which will be found to contain :—

Valuable articles on the best methods of tree-growing, and actual results obtained by three of the most experienced tree-planters in Ontario.

Extracts from Dr. Mayr's Report to the German Government on the condition of the North American forests, translated especially for this Report.

Complete statistics gathered from New York and Michigan States and Ontario concerning the effects obtained from windbreak protection.

Instructive correspondence from all parts of Ontario respecting the forestry experience of different sections.

Articles contributed by Professor Fernow, Washington, on Forestry, and by Dr. Bryce, Toronto, on Forests in Relation to National Health.

Respectfully,

R. W. PHIPPS.

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INTRODUCTION.

This present report, intended, as were former ones, to check the deforesting of Ontario, and encourage, as far as lies within its power, replanting, will be found to contain much new information with regard to the various branches of forestry, and the advances being made in that direction, both in this and other countries.

It is gratifying to be able to state that, in many parts of Ontario, much greater thought is now being given to this matter than formerly. In the more wooded parts of Ontario, of course, clearing still goes on, but it is not done under the impression which once seemed to exist, that the supply of timber was everlasting, and many settlers, warned by the example of the front townships, are giving thought to retaining a sufficient reserve of timber on their farms, though it cannot be said that there much planting is being done.

In the older townships, however, which have lost a great part of their original forest, much interest is being taken. Last spring, I have travelled some thousands of miles through Ontario, and in all directions could be seen lines of young and lately planted trees, along the fences and roads. It is true that many of these had not been so well cared for since planting, as they might have been, and some had died. Still, a large proportion were thriving, while occasionally, a farmer had planted an extended treble or even quadruple line of trees. I did not notice, however, plantations of some acres of young trees such as one frequently sees in the United States; but these will arrive in time, while at present it is safe to say that much interest has been aroused, and that many thousand more trees are being annually planted, than has ever previously been the case in Ontario.

It must not be supposed that this at all so general as could be wished. In many localities little is being done, but a commencement has been made, and we know the proverb which says, "What is once commenced is half finished." One feeling, which is having great influence, is this:—Many farmers have an idea at some future period, of selling their farms; and a farm does not sell nearly so well if quite cleared, as if it possesses a thriving piece of forest. So, to preserve such a piece, on many farms, cattle are now being fenced out of a portion of wood land, and some attention paid to thinning or otherwise caring for the young trees, which, where sod has not taken possession, soon spring up.

It is greatly to be hoped, however, in the interest of Ontario, that much more rapid progress will be made. If every farm possessed (what a little trouble would give it) five, ten or fifteen acres of good timber, having besides, its orchards and outbuildings sheltered by a beautiful wind break, say of the Norway spruce, or our own more lasting, if slower growing, white pine, life on the farm would be more comfortable, travelling in winter much easier, the appearance of the country greatly benefited, the most important crops, both of grain and fruit, greatly increased by the shelter afforded, and, above all in value to the country, the climate would be greatly improved, and the rainfall more regularly distributed.

On the last mentioned point a few additional words may here be well said. Throughout all North America, or rather that vast portion formerly wooded, the settler in general has pursued but one course. He has cleared more of the land than he can farm to advantage; the absence of a sufficiency of trees has seriously diminished the crop of grasses, and thus it is hard to obtain enough manure to allow it to be kept in good tilth. The result is, emphatically, that the land is drying up, and being washed away into the water courses. To use the expression of the late Captain Eads with relation to the great Mississippi valley, "the United States is tearing out the heart of the country with her gang-plows and throwing it into the Mississippi river." We have been too long, both in Ontario and Quebec, washing our land in this way into the St. Lawrence and the lakes. This is one of the great evils which the forestry movement is intended to check. We shall now notice what progress is being made in forestry elsewhere.

FORESTRY REPORT, 1889-90.

FORESTRY INTERESTS IN THE UNITED STATES.

Limited space permits only brief mention of the most notable events in the progress of forestry reform through the country during the last year.

Early in the year and soon after its annual meeting at Atlanta, Ga., a committee of the American Forestry Congress waited upon President Harrison and presented a memorial urging the adoption of an efficient Government policy for the preservation and protection of the public forests, and expressing the hope that the President would call the attention of Congress to the subject with a favorable recommendation of the action which was desired by the Forestry Congress.

At the meeting of the Forestry Congress (now having changed its name to that of the Forestry Association) at Philadelphia, in October last, a petition to Congress was adopted, urging the passage of an act withdrawing from sale all forest lands belonging to the nation, and committing them to the custody of the army, until a commission shall have determined what regions should be kept permanently in forest, and shall have presented a plan for a national forest administration. The appointment of such a commission through the President, and necessary appropriations, were also asked for.

The desirability of having a course of instruction in forestry at the agricultural colleges and of forestry experiments at every experiment station formed the subject of another resolution.

It deserves to be noticed also that the American Association for the Advancement of Science, at its meeting in August, at Toronto, appointed a committee to represent the forestry interests of the nation to Congress.

Pursuant to the action of the Forestry Association, a forcibly written memorial has been addressed to the United States Congress, asking that the public lands in the arid regions of the West be withdrawn from sale, until it can be determined what portion of them are situated within the natural water-sheds of streams; that these be placed in the custody of the Department of Agriculture, the timber only thenceforth to be sold, and the land kept as a permanent forest reserve.

A similar memorial has recently been presented to Congress by a committee appointed at a convention of the citizens of Fresno, Tulare, Kern and Merced Counties of California, asking for the permanent protection of the forests lying upon the water-sheds of those counties.

A memorial prepared by the State Board of Forestry of California presents the same requests in a broader application.

A movement has also been made in Colorado for the establishment of a public park in that State, a principal object of the movement being the preservation of the forests of a region which is the source of several large streams.

The fourth annual report of the Ohio Forestry Bureau shows a gratifying progress in advancing the interests of Forestry in that State.

In Pennsylvania, although the Forestry Association failed to secure from the Legislature the establishment of a permanent Forest Commission, they were successful in obtaining the repeal of the fence law, which had been upon the statute book ever since the year 1700; a law which left the forests of the State largely exposed to the intrusion of cattle and their consequent injury. The repeal of the law will be of great advantage to the forests which remain.

In New York the report of the Forest Commission for 1888 indicates the need of a change in the laws in regard to the redemption of the land and the cancellation of the titles, in order to prevent the loss by the State of much land, valuable as a part of the forest reserve, which recent enactments have been designed to secure. The commission also asks that the further extension of railroads in the counties embraced within the forest reserve shall not be allowed, as such extension cannot be regarded otherwise than as a calamity. They also ask for such an appropriation from the State treasury as will enable them to purchase, for the purpose of increasing the forest domain, such forest lands as can be bought at a fair valuation.

In New Hampshire, the last Legislature established a commission "to examine and ascertain the feasibility of the purchase by the State of the whole or any portion of the timber lands upon the hills or mountains of the State, near summer resorts, or bordering upon the principal sources of the water supplies needed for manufacturing purposes, with a view of preserving the same as public lands and parks." The commission is organized and actively at work.

In Massachusetts a notable forestry movement has been made by the town of Lynn. At the first settlement of the State, Lynn, the second town established in it, had a wild piece of woodland which was held in common until 1706, the proprietors being free to enter it and cut fuel and timber to supply their needs. At the date mentioned the tract was divided among the landowners. It is a region of rock-ribbed hills with bold ledges and precipitous crags, the intervening glens and valleys coursed by clear and rapid brooks and rills and having in their depths extensive swamps and ponds. It is now to return to its original character of a woodland held in common, and be, in addition, a free pleasure ground. The city council lately decided to take advantage of the public park act of Massachusetts, and made an appropriation of \$30,000 for the purchase of the land, which, with private subscriptions, gives a fund of about \$450,000 for the purpose. A board of park commissioners, evidently the right men for the place, has been appointed, and they are now taking the land by right of eminent domain. The park commission, the water board, and the public forest trustees will act in harmony in the administration of the region as a public forest—which it will be pure and simple, with no attempt to incorporate the ordinary park features into its plan. There are about 800 acres to be taken, which, with that already held by the forest trustees and that taken by the water board—including 200 acres in the ponds—will make a total of about 1,400 acres, which may be still further increased. This forest will be the largest area dedicated to park purposes in New England. As a writer in *Garden and Forest* has said: "Lynn has thus led the way in establishing the first public forest, and thus set a noble example which ought not to be without effect upon other communities."—*Washington Forestry Reports*.

PROGRESS AT WASHINGTON.

During the year, in addition to making up reports, travelling, and delivering forestry addresses, the United States Commissioner at Washington has sent many young trees to the following States :—Dakota, Nebraska, Kansas and Colorado. The names of the species, the number sent to each State and the number living after one year will be found in the following table :

NAMES OF SPECIES.	DAKOTA.		NEBRASKA		KANSAS.		COLORADO	
	No. of plants sent.	Per cent. living.	No of plants sent.	Per cent. living.	No. of plants sent.	Per cent. living.	No. of plants sent.	Per cent. living.
<i>Pinus Sylvestris</i> (Scotch Pine)	575	7.	350	14	725	3.4	500	8.4
<i>Pinus Austriaca</i> (Austrian Pine)	575	5.22	350	9.1	700	0.57	500	9.6
<i>Pinus Strobus</i> (White Pine)	400	5.25	25	0.0	125	0.	25	0
<i>Pinus resinosa</i> (Red Pine)	0		0		0		0	
<i>Pinu mitis</i> (Short-leaved Pine)	0		0		0		0	
<i>Pinus ponderosa</i> (Bull Pine)	0		0		0		0	
<i>Pinus laricio</i> (Corsican Pine)	250	11.6	0		125	0.	25	0
<i>Picea excelsa</i> (Norway Spruce)	500	8.8	25	16	0		0	
<i>Pseudotsuga Douglassi</i> (Douglas Spruce)	225	0.9	225	24.4	325	.61	350	5.7
<i>Libocedrus decurrens</i> (California White Cedar) . .	0	0	0	0	0			
<i>Juniperus Virginiana</i> (Red Cedar)	0	0	0		0			
<i>Taxodium distichum</i> (Bald Cypress)	0	0	0		0			
<i>Larix Europœa</i> (European Larch)	475	9.47	25	0	0			
<i>Fraxinus Americana</i> (White Ash)	125	60.	0		0			
<i>Fraxinus viridis</i> (Green Ash)	175	44.6	75	60	100	21	200	31
<i>Prunus serotina</i> (Black Cherry)	25	48.	5	80	5	0	5	20
<i>Gleditschia triacanthos</i> (Honey Locust)	4	0	25	20	125	44	325	29.8
<i>Robinia pseudacacia</i> (Black Locust)	25	0	25	4	0		0	
<i>Catalpa speciosa</i> (Hardy Catalpa)	75	25.3	275	62.9	600	50.5	175	33.14
<i>Acer dasycarpum</i> (Silver-leaved Maple)	150	40.	25	24.	25	1.	0	
<i>Negundo aceroides</i> (Box-elder)	150	60.7	25	80.	25	80.	25	100
<i>Maclura aurantiaca</i> (Osage Orange)	4	0	0		0		0	
Total	3733	14.62	1455	26.06	2880	14.76	2130	16.66

THE OTTAWA GOVERNMENT.

The Ottawa Government is lately doing some work in forestry, principally however, with a view to tree planting on the prairies. What is being done is thus described :—

“First, to induce and encourage a desire on the part of the settler in the colder and more exposed portions of Canada, for tree planting and shelter belts; second, to ascertain by carefully conducted tests in different sections which varieties are most desirable, and third, to plant those varieties of trees best adapted in such as will tend to bring about the more favorable forest conditions as above noted. Of course this last proposition is one that can only be taken up after the satisfactory solution of the second.

Belts of forest trees, 150 feet wide, have been planted on the north and west sides of the Central Experimental farm, comprising about 10,000 trees. The one on the west side is made up of forty or fifty different species of deciduous and coniferous trees. They have been planted in irregular groups, overlapping each other in different forms, which detracts from the stiff effect that square blocks present. The other on the north side has the same varieties, with the addition of certain hardy shrubs indiscriminately mingled at regular distances—somewhat approaching natural forest conditions. This, when compared with the other, will in time give accurate data in regard to the relative benefits of what might be called mixed and individual planting. Also in relation to hardiness, rapidity of growth, freedom from insect pests, timber value, which may be expected to add much to our present knowledge of timber culture. Thus far none of the catalpas, honey locust, Russian mulberry and American sycamore have proved entirely satisfactory, suffering from the cold each winter. Black walnut, when grown from northern seed, promises to do well. Trees grown from seed three years ago and undisturbed, are now six to seven feet high. Box elder, Russian mulberry, black cherry, yellow locust and soft maple (*Acer dasycarpum*) are the most rapid growing varieties in the belt; although for economic purposes white ash is one of the most valuable trees to plant.

One of the first things undertaken in connection with this department of horticulture was to obtain a large collection of the seeds of the hardiest Rocky mountain and East European conifers, including the beautiful blue spruces and magnificent firs of the former region, and the hardy forms of Riga and stone pines of the latter. As a product from these collections, about 175,000 seedlings were transplanted from the seed beds last spring and will be reserved, when of proper size, for distribution to points where their usefulness has not yet been tested. The branch farms, of course, will receive liberal consignments of these; as well as other experimenters who can be depended upon to give careful returns.

For the past two years distribution of trees has been made to the C. P. R. gardens, twenty-five in number, and situated at different points along the line. The Indian and mounted police stations have also been the recipients of liberal collections during the same period. All these stations, covering a variety of soil and climatic conditions, will very speedily bring such light to bear upon the forestry question in the North-west as will enable the settler to select with greater certainty the trees likely to be adapted to his locality.

The above work was supplemented last spring by a distribution of 100,000 small forest tree seedlings, of the hardiest variety obtained from northern sources. These were sent to voluntary applicants in bundles, each containing 100, and were carried through the mails free of charge. Very satisfactory reports have been received as to their condition on arrival and the growth made after planting. The reports to be sent in after wintering will, however, be much more valuable. Arrangements have been completed to continue this line of experiments on a larger scale, and double the number will be sent out the coming spring.

WORK IN ONTARIO.

In Ontario during the year, in addition to compiling the present report, many forestry lectures have been given, and the press has been largely used for the circulation of forestry literature, over 600 letters and articles having been printed

in that of Ontario alone. In addition, the Ontario Government fire rangers, of which a large number are employed, half their expenses being paid by the Government, and half by the lumbermen, have been doing good service. This is a most important work, as forest fires in Canada have destroyed immense ranges of valuable woods. The bonus promised for planting lines of trees has had an excellent effect, many thousand trees having been planted under its influence.

EUROPE.

In Germany, where forestry is regularly pursued as a science both by the Government and individual proprietors, the work of one year shows little dissimilarity, to that of another. All through the country, a portion of each forest will be cut down, and a similar portion planted. This is done in regular rotation so that next year another portion of the forest will be fit to cut, the next year another, and so on until they come back to the one planted this year. Managed in this manner, the forest lasts for ever, and from the even distance of planting and careful management, an acre there will yield much more timber than the same amount of land in the virgin forests of Canada.

In France and other European countries, though the system of tree growing is not always so exact or scientific, much care is being taken of the forests, especially in planting the sides of precipices.

It should not be forgotten that the United States, and the Dominion Government have made large forestry reservations in the West, but it is one thing to make reservations, and another thing to keep them so when settlement begins to surround them or careless tourists, (as is already the case in both of these) occasion destructive fires.

HOW SHALL WE PROTECT OUR FORESTS ?

The following article was written in reply to a request from the American Association of Science, the object being to sketch out a plan applicable to most or all American communities :—

AROUSING PUBLIC OPINION.

Each State or Province should employ a competent official to obtain information on the subject, and circulate it by means of pamphlets generally called Forestry Reports. With these, two things are advisable ; first, that they be written in an interesting style, for mere dictionary statements on the subject would simply be left unread ; next, that they be widely distributed, and among proper persons, not merely sent to officials and prominent men, on whose shelves they are likely to remain untouched. An excellent method is that of obtaining, from some well informed person in each locality, the names of all he knows likely to read with profit such a book, and sending one by post to each on his list. In addition to this, it will greatly aid if the forestry official be able to address, during each year, many communications to the press throughout his State or Province. In addition again, addresses delivered at many points each year will be found of great service.

FREE DISTRIBUTION OF TREES.

Young saplings, obtained in the forest, are very inferior to nursery-grown plants. The forest sapling has generally two or three long roots, which cannot be obtained in full extension, or carried or planted if they were. They must be cut and the chance of growing risked. Then, many of them are grown in the shade, and will not stand the open sun. On the other hand, the nursery-sapling, twice at least transplanted as it should be, gets a more bunchy and fibrous root each time, and naturally grows far better when placed in its ultimate position. Very small trees, especially evergreens, can be, indeed, and often are, taken from the forest and planted in the nursery, when, after two transplantings, they have excellent roots. But when obtained from seed, or when young from large nurseries, the work is far more easy and certain. When one goes for trees to the bush, though saplings apparently be countless, it is surprising what trouble it will take to find what is wanted, and to get fair roots then. Again, in our settled country where cattle are often made free of the bush, young trees are hard to get in any case. For all these reasons, if the farmer had available, when he was ready, some thousands of good, well-rooted healthy saplings of the kind he wishes, he would often be willing to plant and care for them. Therefore, I consider that a large public nursery, where trees might be obtained free of cost, would be one of the greatest inducements to land-owners to plant. It will not do to say that he who wants trees should buy them. There is an inducement needed here, or the work may not be done. The work is national; it is the nation desires the farmer to plant the trees; it was the fault of the nation that he was ever allowed to obtain public land at first without an agreement to retain a certain portion in trees. I have now, for seven years, been examining this subject, and I am strongly of the opinion that under a system of free saplings, twenty times as much planting would be done as at present. Instead of free nurseries, governments sometimes give grants of orders on nursery men. With careful and earnest supervision, either plan would answer. The great point is—free distribution of young trees.

SETTLING FRESH WOODLAND.

The great error of the original settlers was taking hill and hollow, mountain and valley, indiscriminately, for settlement. The result is that many mountain tops were cleared, farmed, and ruined, for the soil washes away, and in a few years nothing remains but to desert it and go elsewhere. That the mountain should be wooded and the sloping valley cropped is the very A B C of forestry, and this should be secured by saying to the settler, "you cannot have such a lot; it is a mountain top; it must stay in wood; and if you take such a lot you must agree to keep such a part in wood, and to keep cattle out." This may seem harsh to the settler, but in the end it would be far better for him. If there is one lesson

more than another which over-clearing has taught America, it is that people should not be allowed to enter the woodland to hack and hew as they please. There are now millions of acres of deserted and worn-out farms, in the Eastern States and Canada, which were simply the elevated ridges, fit, with care, to bear timber for ever, but not fit for farms, as the earth washes off. It is hard for the settler in a forest to know the elevation, but the survey should have regulated matters. I wish it to be understood that here I speak from my own experience. When over thirty years ago, with no one to guide us, many of us entered the forest, we cleared much land that should never have felt the axe, and is now worthless, or very near it. This is not proposed in the case of the ordinary rolling land of the country, nor where there are a number of small hills. But where thousands of acres form the water-shed of a mountain range, they should remain in wood.

FOREST RESERVATIONS.

Forest reservations of twenty or thirty miles square, should be left at those places, found in most countries, where the sources of many streams arise, that the rivers which pass thence through the rest of the country, may be preserved. These will form reserves where timber will grow, to be thinned, not cleared, at maturity; they will also give shelter where birds and animals, otherwise in danger of extirpation, may still live; and, as the country around is cleared, they will be invaluable for summer resorts. These would, if cared for, remain beautiful remembrances of the pristine forest, full of sylvan glades and delightful groves, retaining the undergrowth, the wild flowers, the deep leaf bed, the pleasant freshness of the virgin forest. In this state they are most valuable preservers and distributors of moisture. But if left without care, fire will here and there burn the hills to the barren clay, cattle will destroy the undergrowth, and the whole scenery appear dry and desolate, compared with what it was, and might still have been. Two things, then, are here necessary: prevent settlement there and appoint caretakers.

REMISSION OF TAXES ON WOODLAND.

It would greatly assist in preserving a considerable amount of forest throughout the country, if taxes on woodland, where the country is sufficiently cleared, were in all cases remitted; and if, in the same connection, some stipulation were made that cattle should, to a proper extent, be excluded, very great benefits would follow. For it may be here remarked that a wood dried up and hardened—its undergrowth destroyed by cattle—is of very little value climatically, compared with one where the forest-bed is preserved. Neither will it remain a store of fuel, or, there being no young trees, the forest must ultimately die. There is no doubt, however, that many of these wood-lots are allowed to decay, because it is

intended to clear them up, and that, if the remission of taxes induced the owners—as it in most cases would—to keep them as permanent forest, much better care would be taken of them.

TREE CLAIMS.

In prairie countries, sections of land have been given free to settlers, on condition that a certain number of acres, generally ten, were planted with trees, and kept in good condition for a certain period. This has been tried for years in the States, but many frauds are said to be perpetrated under it. I have myself found when at the great private nurseries in the West, where the young trees were procured, that it was always a practice to purchase the worst—the culls, in fact, for tree claim lots. The system was nevertheless valuable, but needs to be carried out in good faith, by competent and firm inspectors. The prairie lands of both of Canada and the States, urgently need tree-planting, and will give good returns. Plantations of miles square have been grown these eight years in Kansas by railroad companies, and with good paying results. Yet, even with this successful example before their eyes, settlers plant little. When I saw them they were four and six years old, yet still the prairie for hundreds of miles was comparatively treeless, though all admitted the benefits of trees. I should recommend in prairie countries, while the soil is yet in government hands, that many millions of young trees be planted and cared for under government appropriations, cultivated to keep down weeds for a couple of years, and the prairie close by ploughed to prevent fire running to the trees. In this we should not wait for experiments long. It is necessary to plant four times as many trees as needed, to allow for thinning, and by planting different varieties, it would be easy so to arrange them that even if three-fourths failed, we should still have a forest. But three-fourths would not fail. This would cost millions of dollars, it is true, and it is equally true that it is a matter in which, above all others, millions should be spent. If, when I first saw the prairie States, between thirty and forty years ago, an appropriation of ten millions of dollars had been given to plant trees and care for the groves then existing, these States would, I am well assured, be more valuable by a thousand millions of dollars now. Can nations not afford such sums? Let us think of the sums they are without exception ready to spend in war, and then answer. But that, it may be said, is to preserve national life. So is the other. Every well-informed student of history is aware, that in all the past, as the forests of a country were destroyed beyond a proper proportion, national life weakened, and by the time when, as examples show us, the land had become but a treeless desert, the nation was dead.

PRESERVING TIMBER FORESTS.

The preservation of these has been little thought of in America, and the lumberman, on condition of paying the authorities a certain amount, has been too often allowed to cut at his pleasure. No care has been taken to replant forests.

In Europe, on the other hand, the wood-buyer is carefully instructed as to what portion he may clear or thin, while, as soon as the ground is ready, it is again planted, or the gaps filled. Two reasons for the American practice existed: first, farm land was needed. This reason is not now valid, as the pine land now left is very largely too poor for agriculture. Second, and chiefly, the timber could be sold. Matters have now come to pretty much the following condition. This generation, say for thirty years, will have timber enough, though they will have to use much wood hitherto thought unfit. After that, there will be little good pine, and not much good hardwood in our present forests; what is obtained will be brought from British Columbia and the forests of the Southern States, while the generation following will exhaust these. Considering the well-known benefit of keeping a large section of the country in forest—benefits which it is not the province of this paper to state—I would earnestly urge the people of America to consider how much more advantageous it would be at once and decidedly to say of certain large portions now in forest, “These shall not be cleared for settlement—these shall be sacred to the tree.” Once this determination is arrived at, the rest is easy. Nothing is more simple than to introduce and maintain a method of forest preservation, if populations demand it, and governments fulfil their desires.

It is often said, “We have a large proportion of forest land.” But most of this is not good forest. Much has been over-run by fire, much culled of every good stick by the lumberman. But nearly all of this might be renewed, and made good, permanent forest, if the means were used.

MEANS USED IN ONTARIO.

I will close this paper by stating what is done in Ontario for forest preservation. Much forestry literature has been for years circulated by the local government, and with good effect. A money bonus, half paid by government and half by the township, is given for the planting of lines of trees, in good condition after three years, in every township which chooses to adopt the law. Over fifty rangers, half paid by government and half by the lumbermen, are kept in the woods during the summer months to prevent fires—a very valuable measure. An Arbor Day is also yearly held, with excellent results.

Finally the answer to the question, “How shall we protect our forests?” is “Spend more money in their preservation, and be less eager to make money by cutting them down.”

FORESTRY OUTSIDE OF FORESTS.

While it is very necessary to preserve the Canadian forests, it is hardly so necessary, using the meaning generally given to the phrase, as is the exercise of other forestry precautions. By the phrase above used is generally meant the long stretch of forests to the north of cultivated Ontario, leased or unleased to

lumbermen, partly culled by them and partly yet untouched, not at all, we must remember, such a forest as we cleared in old Ontario—we may look in vain for the immense stretches of great maples and tall beeches once so common to the eye, nor do we often see even a specimen of the large pine trees, which in deep and lofty groves once intermixed the maple forests throughout much of Ontario. But these are no more. North of us we have a vast forest containing much pine and hemlock—much young poplar on the burnt lands—here and there an immense black birch—here and there some beech and maple. But this great forest is to our north, and cannot in its principal climatic bearing greatly influence older Ontario. The south-west wind is the rain bringer—its rain clouds are precipitated by this forest, and fall in showers somewhere to the north of it. They do, indeed, greatly help the more southern counties in another manner—that is, by preserving from drouth the sources of the streams which run this way.

We will put aside for the present the question of these northern forests. What is much more important to the inhabitants of Ontario is the preservation of the small portions of forest yet remaining in her older districts, and the adding to them of many more. It is not, in fact, where our large forests exist in Ontario that forestry is most needed. The main effort should be where the country has been mostly cleared, to endeavor by planting wind-breaks of one or more lines of trees—by commencing plantations of young trees taken from the forest or purchased from nurserymen, afterwards to be replanted at greater distances; and by—perhaps the chief of all—endeavouring to preserve what small portions of forest we have left standing there, that we can hope to bring back, to any considerable extent, the former climate of Ontario.

That this climate was far better calculated to aid fertility than our own there is now no question. In one year I have obtained the testimony of above two hundred farmers on the matter, and their unanimous evidence was to the effect that years ago, when there was still much timber standing, most crops gave a far better return than since more has been cleared. There is no denying that this is largely the case. The fall wheat, for instance, grew very much better, and with this of course the clover flourished. When we consider how valuable these two crops are in a proper farming rotation, what we have lost by the change of climate can easily be calculated. Speaking of the evidence mentioned above, it was principally obtained by a thorough examination, lot by lot, of two townships in northern and southern Ontario, obtaining the opinion of their holders as to the difference between the climate now and that which existed when the country was one-third or more forest. Their statements were almost invariably as follows:

That the rain was, to answer the farmers' purpose, much better distributed throughout the year, there being during spring, summer and autumn, frequent mild and fertilizing showers, lasting perhaps for days, penetrating deeply into the earth, and remaining there for a considerable period before drying out; thus

giving that continuance of warmth and moisture to the land which affords the growing plants the best opportunity. Neither was this weather, except perhaps in rich low soils, more productive of rust than that of the present day.

That now, on the contrary, rain too often falls in heavy sudden masses, beating the young plant into the ground, or causing the grown grain to lodge.

That these heavy showers tend much to weaken and impoverish the land, especially where at all sloping, by carrying away the richest soil; for instance, where furrows had been ploughed down a slope and heavy rain came on, each would resemble the next morning a deep water-course.

That formerly, when sufficient shelter existed, rapid winds had no injurious effect on the soil, but that now they dry the moisture too rapidly out of the land.

That owing to the combination of these causes, added to the fact that very few farmers had the means of procuring sufficient manure to supply the deficiency, a large proportion of the land in the country no longer produced the same amount of certain crops which could be formerly grown on them with much less labor.

That wherever the woods have been cleared in too great proportion, numerous springs which formerly existed had altogether dried up, and even creeks and small streams, once running the year round, were now, excepting in times of floods, nearly or quite dry.

That in connection with this the moisture had receded from the surface of the earth—that is to say that where water might easily once have been obtained at a few feet in depth, now wells must be sunk much deeper before a spring is struck.

The general impression was in all places visited—an impression corroborated by statements from many different parts of the Province—that too many trees had been cut down. It was found also that generally farmers of means, who were able to do so, were planting many trees, mostly in lines along their fences, for the purpose of wind-breaks. Many others of less capital stated their intention of doing so when able. Few large plantations of grown trees planted with this view were found, those existing, planted perhaps twenty or thirty years ago, having been set out more with the view of open parks than with any forestry purpose. Many farmers, however, had numbers of small trees growing in nursery patches, some from seed, some purchased in quantity when very small plants from nurseries either here or abroad, which they intended when large enough to set out elsewhere. As for the portions of old forests still standing on various farms, many farmers allowed their cattle to run in them—a proceeding of course fatal to the continuance of the forest, as the young trees being thereby destroyed, its means of perpetuation are lost. On the other hand some, with a view to preserve a portion of bush, had carefully fenced it.

It was also generally stated that wherever trees and shelter were plenty much better crops of both fall wheat and grass, especially clover, were secured.

From these data taken altogether the conclusion was drawn that while the principles of forestry are rapidly being better understood throughout the Province, and in many cases acted on, there is as yet scarcely one-twentieth as much being done as should be.

With the many competitors now in the field, Ontario cannot profitably remain a wheat growing country. Her main hope for the future must be in grass and cattle, and it is impossible to produce these profitably and in large quantities in a dried up land. Too many farmers are now, in the effort to raise a few cattle, killing the goose that lays the golden egg. They are allowing their bush lots to be dried up in order that their cattle may run through them and get some shade and a little pasture. In a little while the young trees are eaten off, none grow up to replace the old ones, a poor sort of grass overspreads the earth, the large mature trees fall one by one, and shortly all is so open and worthless that the farmer thinks it would be far better in crops and cuts it down.

As far as the cattle are concerned they benefit but little by it. As a long experienced farmer and planter elsewhere in these pages remarks, one acre of good grass outside the forest is better than twenty acres in. There are, however, other ways whereby shade and bush pasture may be had for the cattle. In the first place a portion might be set apart for them and a portion for forest. In the next place groves may be planted so near grass-fields as to give shelter without allowing the cattle within them, if of trees likely to be injured thereby. They are sometimes planted in the form of St. Andrew's cross, sometimes in that of a double crescent divided in half by the fence between two fields. There will then be shade as the day passes on from all points of the compass in these two fields.

What injury cattle will do to forests when in good leaf, and how rapid is its progress when there is no good pasture to be had outside, few are aware. They will easily pull down saplings fifteen or sixteen feet high, bite off all the leaves in the head, let the tree fly up again if they have not broken the stem, and pass on to another. They will, too, destroy much older and much better trees. I have seen one walnut plantation out west nearly ninety feet high and the trees two feet six inches through at the butt. They are not mature yet, but the owner expects in about fifteen years' time that they will average five hundred dollars a tree, which, as there will be a hundred large trees to each acre, will be \$50,000 an acre—many times as much, of course, as could have been raised in crops on any adjoining acre. There is an adjoining acre, however, where cattle have shown what they can do. It had to be cut off from the rest to allow the cattle, which are many and large, to pass to another part of the farm. There are or have been in it about a hundred walnut trees which must have formed a fair grove at the time it was thrown open, as the trees are many of them sixty feet high. But they are all dead—the acre of land has been tramped hard all round them and their trunks have been rubbed by the cattle till the outside of the bark is all rubbed away.

Here had been, as well as I could calculate, fifty thousand dollars lost in order to yield an amount of pasture and shade which could easily have been obtained for four hundred.

As described above, some similar process is going on all through our country, wherever the old portions of forest are being allowed to dry and wither down, largely assisted, in many soils tending to be shallow, by the wind perpetually blowing down outside trees (a thing to be checked by planting evergreens at the outside.) Then there is the perpetual demand for fuel, and as described, the inroads of cattle, of which Professor Sargent, the chief authority in America, has said that "not all the injury by axe and fire has done so much harm to the American forests as the browsing of domestic cattle."

There is every proof that by deforesting we have rendered Ontario no longer the fertile land it once was. The climate has deteriorated, but as in the case of springs which, dry for years, were renewed when a fresh growth of trees was planted round them, so our climate is capable, without any unreasonable care or expense, of being renewed again to perhaps its pristine vigour. We want our lands in the future valuable for dairy purposes, for butter, cheese and the raising of cattle; and where forests, rich grass and flowing streams exist is the very home of these. The possession of many cattle makes the growth of crops easy. What is wanted is to have the great expanse of cultivated Ontario not indeed again reforested, but to revive again a sufficiency of our forests. It is doubtful whether, over much of that country, the true forest, valuable for climatic purposes, covers more than one-twelfth of the surface; for as we pass through what are supposed to be small forests we find many of them little better than a sort of mongrel description of park—a hard hoof-beaten surface covered with short poor grass with a few large trees, the small trees, except those that are worthless, all eaten down. These cannot serve the purposes of forests—the forest soil is gone, it has no longer the power of holding water—of storing up reservoirs of rain to be furnished to the dry springs in due season; nor has it the vast mass of undergrowth covering the surface of the earth that keeps cool and moist the actual forest.

Of actual forest in good condition there is probably scarcely one-twelfth throughout much of Ontario. To raise this to one-fourth should be our object, and this is that forestry outside of forests we should endeavor to promote. When people talk of the forests of Ontario, as to whether they are being taken care of, they are too apt to think of the lumber districts. These of course are valuable—they bring a large revenue—and though some politicians complain of the way in which they are managed, they are certainly better cared for than any other forests in America. But if we could by reforestation bring back the former climate—the summer showers and fertile growth of older Ontario, the profit to our people would quadruple that which the lumber forests can ever bring us, manage them how we may. It is forestry outside of forests that we need most in Ontario.

MR. GOTT'S OBSERVATIONS ON FRUIT AND FOREST GROWING THROUGH WESTERN CANADA.

I must ask my readers to go carefully through the following article, which will profit both those who grow fruit, and are interested in sheltering their orchards, or who are planting or intending to plant trees for forest purposes or general farm shelter. Mr. Gott is a successful fruit grower, and in the matter of forest and shade tree planting and raising, few plantations I have seen are equal to his. It is about six years since I have seen his place. I particularly remember that the wind-break of Scotch larch of which he speaks was then very fine, and must now be most beautiful and useful. With regard to what he says concerning the free distribution of young trees, it should be remarked that, although not succeeding as well as might be wished, yet where it is desired to plant large surfaces, it is hard to suggest anything better. Mr. Gott objects to it also as interfering with private enterprise. It is not considered to do this to any great extent in other countries, such as those of Europe, in some of which it is largely used. There are two reasons why this should be the case. In many governmental affairs, governments though maintaining large establishments of their own for the purpose, are by no means hindered from taking, in time of need, large contracts from outsiders, as may often be noticed in the building of ships, and the purchase of material for warlike purposes. So, also, governments which maintain nurseries for purposes of free distribution, often give large orders to private nurserymen, who furnish them with trees at a low rate for the same purpose. It furnishes, too, a sort of counter-check; the government nursery, if well managed, should afford an example in the matter of growing trees well while the private nurseryman, on his side, who gets a government order for young trees, can afford the stimulus of showing how quickly and cheaply he can grow them.

The second reason I wish to give is as follows: Let us suppose the government giving out many young trees, and farmers planting them largely throughout the country. We all know how prone we are to follow in each other's footsteps. Even in a path across a meadow, we never make a straight line—every one follows the deviations his predecessors have made. It would become fashionable; it would be considered the right thing to plant trees, men of means would invest in it, and many of these, rather than wait for the growth of the young stock which alone it would be possible for governments to distribute, would go to the nurseries, secure their best stock—say their twice transplanted trees and those of foreign importation, perhaps no better than our own after all, but costing more money, in order to keep a *leettle* ahead of Farmer Jones, on the next lot, who has just planted a five-acre wind-break with government seedlings. Of course it would be necessary, in all cases of free distribution, that those supplied should bind themselves to fence properly and give good general care to

for some years, the young trees they had obtained free. I am sure also that Mr. Gott will admit that such a quantity of tree-planting as he rightly considers to be necessary in order to restore, to any valuable extent, the now almost forgotten climate of Ontario, which he has so well and truthfully described, would need many more nurseries than we have at present, so that, if even one or two of these were government ones, there would be little loss to present or future private establishments, which would still raise, if not the largest number, at least the much better paying varieties of trees.

It would be well to say a word here concerning what Mr. Gott has remarked about the sowing of pine seed broadcast in the New England States on the sands near the sea shore. So far as I have seen this myself, it is done on large expanses of land near the sea—land which was once, to judge by the old stone fences carefully built round it in many parts, of considerable agricultural value. This was probably two or three hundred years ago, and the land has been cropped and cleared until it was little but a fine blowing sand, forming here and there into large whirlpools. People observing that from an occasional pine tree the falling seeds would grow without culture, sowed them themselves still more broadly, and from then till now they have been sowing them every year. It has been found that in about thirty years this produces a forest of pine trees of shortish build, but giving a considerable trunk from nine to twelve inches through. A portion of this forest will then be cut down and sold for various purposes, the chief of which seems to be the manufacture of packing boxes. Much more is sown, I believe, every year than is cut down; the crop is perpetual, and as there is very little labor, it pays the owner. The experiment has been tried in Ontario, but without success, the seed not taking at all, though it would be well to try it in still other parts of the Province, where light, sandy expanses exist.

Mr. Gott does not consider the scope of Arbor Day work sufficiently large, but it is in accordance with the rest of our forestry efforts. Governments have neither spent nor attempted to spend as yet the large sums necessary for properly re-foresting Canada. What is being done at present may be described as an effort to influence public opinion. I think myself that some more practical measures would now be looked upon with favor by the Ontario public. The school agitation, however, has been of decided service, and may be of more. Perhaps the distribution of a number of sheets containing the rudiments of forestry among the children might be of service.

My own opinion is that the best results would be obtained if Parliament would devote more money to the object by Government either growing, say till a foot high, trees of many varieties, and giving them at that small size and at the proper season to those who would bind themselves to take good care of them, or purchasing the same, or part, from nurserymen, for the purpose of giving them out free. Those who received these little trees would find them to be far better

rooted than those they could obtain in the forest. They should then devote a small plot of ground and proceed according to Mr. Gott's directions, always remembering the description of ground they are working in, and what trees they find formerly grew best there, or grow best there now :—

FRUIT GROWING AND FORESTRY.

BY B. GOTT, ESQ., ARKONA.

I wish to present this paper in its two-fold aspect of, first fruit growing, and then secondly forestry proper, and their practical inter-relation and dependence on each other. Not that I hold by any means that the former is the only department having the essential element of usefulness contained in it, to the entire exclusion of all such pretensions for the latter—far from it. As far as the essential elements of usefulness are concerned, it is thoroughly and everywhere understood that both the departments have them in very large proportions, and I might say in almost indispensable proportions. All successful nations and peoples on the entire habitable globe have felt their condition of helpless dependence upon their tree growths as a first and fundamental condition of their very existence. As far as I know there is not a successful community of people on the earth to-day, outside the deserts of Arabia, that are permanently held together in any form of continuous being. I believe that the original constitution of society is made such by the *Great Designer of the Race*, that if any people or kindred or tongue will wantonly or recklessly injure or destroy their natural inheritance of tree growths so liberally and so generously given them, there is no other influence or power that can be made to serve to hold them together in permanence of habitation. We need only just look into the history of the past and past nations for confirmatory evidence of the weighty and solemn truth of this observation. Tree growth, therefore, and in plentiful abundance, is essentially necessary to the very existence, and fundamental to the prosperity of any people in every age and part of the world. This immense preponderating importance of a nation's tree growth is doubtless the primary reason why it is studied and treated of so much by the most profound and thoughtful of all prosperous peoples. Only witness the profound attention of old Germany and France, of England and the United States of America, in their intense and constant studies of the needs and demands of all questions relating to their national forestry. Not only is this vigilance in all forestry questions shown in occasional though elaborate newspaper articles, but exhaustive pamphlets and volumes of matter are being plentifully prepared, and as widely circulated as the demands of the nation, by the most able, scientific and practical men the nation or the age can produce. Let us further consider, and, if we can, measure the immense importance and power of those annual associations and conventions for discussion and deliberation of all questions of forestry conservation for these countries. Who can properly measure the far-reaching results of such meetings as, for instance, the American Forestry Congress, and the voluminous reports of these sent over the continent? When we consider the make-up of these conventions, and the profoundly cultivated ability and power brought to bear upon them and the questions at issue, we are made to ask in utter astonishment, "What will the future be when brought out in living forms tangible to the eye?"

But not less and nowhere behind the forestry are the fruit-growing interests of this country, now not only commanding the best ability and attention of the

age, but utilizing it and emphasizing it for the highest and best ends of an industry so vastly important and fundamental to our existence as a nation and a people.

Whatever is made to favor and encourage our systematic fruit-growing interests in this country, contributing to its certainty and success, is in the truest and most practical sense helping and assisting us, and thereby so far demonstrates to us its real money value. So and for these reasons we conclusively say that

FRUIT-GROWING AND FORESTRY

are co-related and must go hand-in-hand, and cannot be put asunder but by the most evident and devastating losses to all parties concerned. It is more than needless for me to attempt to detain your readers at this late day with even an outline sketch of the marvellous strides of progress now being made, and that have been attained by our national fruit growing within the past few years. I simply wish to direct attention to and emphasize some of the needs and demands for better methods and results which I believe it quite within the range of possibility to attain by means of friendly protective tree belts around and about the fruit plantation, as well as other forest plantings in masses or blocks over the face of the country. The present position and demands of fruit-growing in this country to-day may be simply stated thus: That we are becoming more and more subject to unseasonable, high, cold and blasting winds that are destructive to the very life of every form of vegetation. These winds are not our own, nor do they originate on this side the great lakes, but on the great high mountain land of the North-West, and in their uninterrupted sweep over this country from the North-West leave their destructive influences and effects behind them. That these winds, far more common than formerly in the history of this country, not only are accompanied by great force to uproot and unroof, but also they bring with them the most intense and destructive cold analogous to that of the unprotected and treeless prairie regions of the west, that not only effectively causes to perish the annual crop of valuable fruit, but in some cases destroy even the trees themselves.

During the spring and blooming season of the year, we are often visited either by cold north-west winds or by blighting easterly rain-storms, just at the most critical period of the young fruit's life, that effectually destroy it at its birth and render the trees bare and unfruitful, all of which is directly or indirectly chargeable to want of a sufficiency of tree protection. Our rain fall is not as formerly pretty equally distributed over the whole circle of the year, but is rather in extremes and excesses at one part and at another a perfect and continued cessation, causing prolonged drouth in the heat of summer, when our fruit and fruit plants need a supply of moisture the most. In consequence of these very discouraging considerations, occasioned as I believe wholly or in part by the removal of our natural forests to an extent greater than is actually needed for economic purposes, we are annually subject to great losses in our fruit crops, causing much injury to our national industries and an immense shrinkage to the revenue of this country. If by judicious tree planting in blocks, in continuous belts over the farm or around the fruit plot or otherwise, we could successfully control those powerful influences and agents that are now apparently growing up against us, if we can direct these and so modify them in our favor we should do so, and that at once without any further delay.

These are some of the conditions, disadvantages and trials of the fruit-men in this country to-day as we see them, and our experiences are pretty large in these lines. These are some of the great and growing oppositions and drawbacks that must be met and overcome before we can even hope to make fruit growing in this country absolutely successful, or pride ourselves that we are able to put upon the market the brightest and best possible specimens of our popular national fruits. Fruit men looked up to as successful men in their profession are men who are overcoming their adverse natural conditions, and are modelling their untoward circumstances for their own ends and for their own advantages. That is, they are men of ability and power of determined will, and of a thorough fundamental, intellectual and physical training in their special lines of business, and they use these qualities in shaping and transforming their surroundings. Their precautions, prelabors and the shaping influence of all their studies are marked and very noteworthy. In the very first movement they select their location to be, as far as possible, every way favorable to the objects and purposes in hand—successful fruit-growing. They require the location to be as much as possible sheltered from prevailing destructive high or cold winds, but more especially from late spring frosts. Such locations when found are of immense value to them because they supersede the necessity of great expense in providing natural or artificial protection from these and involving much loss and time. Again, though they be well protected above from high cold winds yet the soil may be very unsuitable for their purposes by the great amount of water it holds in its composition. They at once employ an elaborate and expensive system of under-draining to render it at once suitable and favorable to the successful production of the choicest specimens of their high art. But in case the former conditions indicated do not exist or cannot be procured to their satisfaction they scruple not to plant trees around the whole plantation in belts and masses to act as shelter and wind-breaks for the fruit plants. These belts or blocks act as the conditions to modify climate, to shear the winds of their cold, and to induce the clouds to drop down their fertilizing showers. They modify those adverse influences that constantly bear upon the work and fortune of the modern fruit grower placed under frowning northern skies—those influences nevertheless that stimulate his activity and call into lively action all the forms of his inventive genius in all matters of protection and success in his chosen calling.

A FEW PRACTICAL EXAMPLES

of judicious tree planting for protection, which have lately come under my personal observation, may be here acceptable.

On travelling not long since in a neighboring county near the thriving town of Thamesville, my attention was arrested by the appearance of a dark pine belt surrounding an orchard and home. My first impression was that it was beautiful, and the perfect realization of an idea I had often formed for myself as to what should be done. The trees were native white pines and stood about 10 or 15 feet apart, their dark waving branches interlacing one another and swinging gently in the summer breezes. The trees had attained a magnificent size, had run upwards about 20 feet, and I suppose had been planted about 12 or 15 years. Their dark, dense and beautiful foliage was admirable and formed a most complete and sure defence against all wild sweeping blasts that might pass that way. This belt of trees was a decided acquisition, and added very materially to the real value and working capacity of the farm as well as the enclosed orchard and household.

YET ANOTHER FINE EXAMPLE.

One of the most beautiful and extensive plantations of our hardy and accommodating evergreen trees that I had had the pleasure of seeing, was inspected by me a few weeks ago near the town of Morpeth on the Lake Erie Shore. The trees were mostly imported Norway spruce and our native white pine, but the spruce greatly predominated, especially for the whole of the inside work. They were originally planted by a gentleman owning the property there, named Mr. Hill, and had been designed not only to protect himself and the precious products of his soil from the well understood tearing winds and roaring waves of old Erie, but also to beautify and add to the natural attractiveness of the spot, in order to form a harbor there, and eventually a large and thriving business centre for trade and commerce on the bosom of the lake. This latter conception, however, he did not bring to realization, but the former is fully up to all and every sanguine expectation. Those trees stand there to-day, in their order and beautiful symmetry, as living testimonies of the designing intelligence and the far-seeing determined energy of the man who was the immediate cause of their order and beauty. The spruce had been planted 12 years ago, and were brought I was told from the United States on barges loaded for the purpose. They have now attained a height of about 15 feet and stand very closely together, viz., about 10 feet apart, and are planted inside the outside belt of white pine in all conceivable fantastic designs of plots and carriage drives, forming a piece of scenery not often witnessed on Canadian soil. Their branches are of an immense length and encouraged to grow out from the very bottom, the lowest ones lying prostrate on the ground, the higher ones overlapping them in regularly beautiful folds, shortening to the top, where there is but one aspiring shoot upward. Their beautiful dark green masses of leaf presented an impenetrable screen to all outside vision, and so being once within their friendly enclosure one would be in happy ignorance of the ungovernable elements without. They beat against it, but only to be beaten back with most resolute resistance on this, one of the most turbulent waters of the whole chain of the Canadian lakes. It was a fine place for reflection within this peaceful enclosure, so full of sermons and so full of beauty. If such astonishing results could be attained and in so short a time, think of the guilty negligence of more than three-fourths of our people in suffering their possessions to be devastated and the soil reduced to penury from year to year, never arriving at the first idea of duty in the way of protection and beauty in planting trees. They suffer, and they deserve to suffer who assist to destroy our natural wealth of forest trees and utterly refuse to plant another to replace them. I have no moral patience with men who in this way are untiring in their efforts to spread devastation and loss over this fair country, until their sufferings make them to cry out and stigmatize the benevolent Providence that is daily over their heads. I say in all honest indignation and contempt, it is a shame! If every man owning our fertile soils and enjoying the peace and plenty of this fair country, would only make a feeble attempt to do what in him lieth to replant and properly re-tree this country, how soon would it present the most attractive aspect to its now largely dissatisfied toilers. It seems to me that however loudly we may talk about our British sires and the firm and solid policies of the old land and contrast ourselves in self-satisfied congratulations with our dashing but flimsy neighbors across the lakes, yet in very truth and actual practical forms of genuine patriotism, we are nowhere in comparison with them in this matter of planting trees. I never go over into one of their cities but I stand in utter amazement at the no end beauty of their street trees. And this same form of patriotism is to be distinctly observed in every city, town and hamlet over the whole country and even over the country itself. Let us be wise and draw practical lessons of usefulness from these observations.

I went a few days ago to Mr. James Bissell's, near Thedford, Ont., to inspect a belt of native white pine he had planted about twelve years ago on the north and west sides of his garden and household buildings. The trees have grown most remarkably well and now present an unbroken front to the fierce winds coming so frequently from these boreal quarters. The trees when quite young were taken from the forest and planted about ten feet apart in single row. They are now 15 feet high and are thickly supplied with branch and leaf. That gentleman told me that he considered the belt of very great advantage to him, and that he would not be willing to take a large sum of money for it, as it successfully modified the temperature to him even in the most intense cold of our winters. In addition to the comfort, they helped to save and mature his fruit, and thus he had plenty for himself and family. At the same time and near the same place I visited

THE CELEBRATED WHITE PINE BELT

on the Thomas farm, near Thedford. I had not seen this place for some time, and I was much astonished at the growth and development it had made, and so demonstrated its efficiency as a wind-break and shelter belt for the family orchard and home. The enclosure embraces about five acres, and the small white pine trees were taken about fifteen years ago from the open forest and planted closely all round the plot. The result has been a most pleasing and profitable success. The trees are to-day about 25 or 30 feet in height, and closely embracing each other in one close compact beautiful waving belt of rich sheltering foliage. During the cold and storms of winter this enclosure offers a most delightful retreat and a safe harbor against all fierce intrusions of wind or frost, and as a result the family dwell together in safety, and the home orchard and fruit gardens are generally, in their seasons, loaded with ripening fruits, rich and refreshing to the taste. Mr. Thomas says that in the coldest days of winter he can now go out with safety and comfort to perform his duties within this enclosure, whereas before it was there he could not stand out in winter to cut his wood. This is a fine example of what can be done with ordinary common native white pine, but we rather think that still better things might be achieved by the use of the best European pines or the spruces planted in systematic order.

THE JAKE ROMPH'S YOUNG PINE GROVE.

This young pine grove is a marvellous product of nature, unhelped in any way by art except the simply fencing them for protection. After the large pine timbers were removed about 20 or 25 years ago the ground was simply left alone, and this thick massive growth of beautiful pine is the result. It is located about two miles north of Thedford, and is on natural pine land on the banks of the flats or flowed lands of the Aux Sable, and embraces about 10 acres. The trees are now about 25 or 30 feet high many of them, and are a dense and beautiful mass of dark green waving pine over the whole block. It is the finest block of young pine growth I have ever seen. A prominent pump manufacturer named Dunn, I hear, has been using from this plot for some time for pump logs, and they so well suit his business that he has offered the proprietor one thousand dollars in cash for the timber on the block for these purposes. This is a fine sample of the successful and rapid growth of the common white pine, and it further shows us how short a time is required to bring these timbers into successful and paying uses, so that the outcry that "he that plants trees only plants for his heirs" is a totally fallacious and misleading one. Amid all the great variety and difference of trees in this country for forest and shade purposes, it is my opinion that we have nothing

that on the whole combines so many fine points of advantage as the common white pine. Other trees, as the cedar and the hemlock and spruces, no doubt have their good qualities and fine ornamental points of great merit, and are indispensable in certain localities and positions in this great country, but for every day use, for our most exposed positions and for everybody's use everywhere there is no tree of such wide and general application as the white pine. In point of beauty, too, when near its full development, say from 30 to 50 feet high, with a full and rich equipment of branch and leaf, it strikes me that this tree is very hard to beat. Its beautiful dark rich color of leaves and their massive plenty, so cheering, so helpful and inviting as they are, softly waving in the summer breezes, and so sheltering and friendly in the fiercest winter storms, and its most useful timber for all purposes in our economy after its death, makes this tree essentially the most valuable and greatest favorite of our times. Nothing makes up for the other defects of a country or enhances its beauty and attractiveness so much as a general and plentiful plantation of white pine over its entire surface. Amongst the deciduous trees I am strongly in favor of the basswoods and the white woods of our forests for all purposes of protection and shade or wind-breaks. The rapid growth of the basswood and the tulip tree when young is most astonishing, and their beautiful color and form of leaf and its intense massiveness and attractiveness, make these two great and general favorites all over the country, on all soils and in all locations. The beauty and sweetness of the basswood in its blooming season in July is one of the most attractive things in nature, and every bee of the air as well as the living things upon the earth all feel its intense and permeating power. As a honey producer, therefore, and that of the very finest and best possible quality, every beekeeper in the land should plant in the most liberal profusion and in every possible empty space many trees of the basswood, and then follow out with a plentiful supply for variety of tulip trees.

In my humble efforts at tree growing I have been very successful at growing tulip trees from seed, in 5 or 6 years to 8 or 10 feet in height, making beautiful trees for transplanting purposes in permanent locations. The same can be done with the bass woods and ashes and catalpa. The beeches, maples and elms require a longer time as their growth is slower and more lasting. Our success with the pines and spruces have also been very encouraging indeed, and we have successfully raised a block of Scotch pine and Austrian pine to the height of 25 or 30 feet in 15 years of growth. This was as handsome and cheering a block of pine as any amateur or professional might desire to see stand on his premises. Their great hardness, their rapid growth and their intense beauty of form and foliage make these trees exceedingly valuable in our country, and seem to fill in every particular the requisites so much desired for our uses.

But I must not forget to mention the Scotch larch as one of the most desirable of trees for belting and ornamental purposes. It is of very sure and rapid growth, and so hardy that no amount of cold or exposure can in the least affect it, and its long slender beautiful pendant branches covered with the most beautiful soft pea green foliage makes it one of the most desirable trees that can be employed for all ornamental or belting purposes. We planted a long row of these 10 years ago along our whole front line. That row is a most cheering and beautiful row of trees 12 feet apart and 20 feet in height, with some of their branches from 6 to 10 feet in length overhanging the road line. It is almost an evergreen, and its many fine branches, even in winter, offer quite an obstacle to the prevailing winds, and a row of these trees two tier deep would successfully serve any purpose of protection. The Scotch larch, therefore, is one of our great favorites that we recommend to all comers. These considerations to us are of vast and growing importance, since the annual plantings of fruit and orchard trees in this country is

very large, indeed, amounting to many thousands of trees in orchards of from 200 to 500 each. This kind of planting is not only now very extensive but is likely to continue in the distant future for many years to come. It is our business therefore to provide at least in part for the grant wants of this future.

THE ANNUAL DEVASTATION AND DESTRUCTION OF TREES.

The naturally inherited wealth of our forests is now leaving us on a very rapid scale, and many people have even now come to the end of their allotted allowance. All over the fair face of this splendid country large and handsome block of native, erect, magnificent timbers that once beautified and served for useful purposes the broad landscape are now unfortunately not there, but are removed by the powerful elements and by the yet more powerful arm of man to satisfy his love of change and his gormandising greed of gain. This loss is a loss that is being even now felt, and we shall yet feel it more and more in our winter's cold and in our summer's heat and drought. The rapid changes in our climate that are becoming annually more apparent, and that people are now becoming so much concerned about, and of their true causes and meanings, I believe will find their true explanation only in the loss of our forests. If scientists can be depended upon and observers can be trusted, it is their united testimony that our trees are our great conservator of moisture and that they are the regulators of the winds. In the course of my short life I can most distinctly notice the great change in the composition and make up of our year. I can remember 30 or 40 years ago, that at that time when the whole of this Western Ontario was thickly studded with perhaps the noblest and most surprising growth of native trees, through whose great branches ever the eye of man peered into the heavens, that the winter's cold was not so intense, and the snow falls were far more weighty and general, and that the summer heat was tempered and the droughts were refreshed by frequent falling showers throughout the whole round of the year. Only compare our annual experience of these times with these recollections, and see the incredible changes that have taken place and that yet will still further take place in the composition of our climate, and their immense effects upon all forms of fruit and vegetable growths all over this country. These changes I believe directly attributable to the loss of our growing trees and fine native forests. The feeble efforts made to replace our trees in this country by a new and younger growth of our own planting as yet little worthy of mention. We have no regular organized system of proceedings in this matter so as to accomplish any very marked results in a work so varied and so complicated. With the meagre exception of the towns and cities over the country, the tree planting for ornamental or protective purposes is very feeble, and in no sense adequate to the actual demands. What are the assignable reasons of the lethargy and deep-seated want of interest of the people of this country in these matters? To answer this question we must no doubt consider the circumstances under which we have been placed for many years, and the necessity of removing a very large part of our primitive forest to make room for our farms and our homes. But now that this is done, and more than done, and when we consider the rapid rate at which our ordinary timber supply is being wasted, surely it is time now to consider some of the measures to be adopted by which this supply may be replenished.

The municipal laws and by-laws that have been adopted to encourage tree planting in many parts of Ontario have no doubt served a good purpose in starting the idea of tree planting amongst the people. But so far these measures have not served to produce such an extent of planting as to effect the object aimed at by them. When we look for a moment at the splendid movements in this

line of our neighbors all through the western and north-western States, and at the truly wonderful results of these extensive tree plantings annually by the millions, and at the encouraging splendid growths that they are securing for these forest trees in almost unmeasured blocks we are perfectly surprised at them and ashamed of our own do-nothingness. We feel that there must be some great movement on the part of our official Minister of State and the government of this great country properly organized, and set on foot, before anything worth to speak of can be effected in this line. Mr. Ross's Arbor Day Proclamation may effect a beginning, but much more important measures will be needed to follow.

Having treated at large of the general necessities of tree planting and of some of the more apparent arguments for its encouragement and advancement in a country such as this, I would now more particularly speak of some of the plans and principles that must be adhered to in order to obtain successful results. In forming your plans for a forest tree plantation of whatever extent—it is necessary to know exactly what you are going to do and why and how you are going to do it. You are going to occupy that soil with plants that will be growing and flourishing there for many years to come, perhaps long after you yourself have done with all earthly things and cares. Therefore, it is very important that everything connected with the work should be done with the greatest care and the best possible precaution. The land itself should be well selected and of good tilth, made ready and fully prepared some time before. We would not recommend, as was done a few years ago by one of the Professors of an Agricultural College, to go to the waysides and woods and take up an immense load of young trees, from 5 to 10 ft. high, and plant them in an old forest pasture by means of an old axe, making holes for them in a strong sod. Of course this was found out to be anything but successful. Forest tree planting, to be successful, cannot be done in that way. Neither would I recommend a practice we are told prevails in the older New England States, of going to the old worn out lands in many places along the sea shore and sowing broadcast evergreen tree seeds and others on those worn out soils, and leaving them to get up, struggle up and grow as best they can. Neither would I recommend the free distribution of young trees by governments, as that is an interference with private enterprise. Moreover, things got so cheaply are not likely to be well taken care of. My plan is as follows:—

Procure the best possible tree seeds from the regular dealer or collect them yourselves of all the kinds you desire to sow. Have the land you intend to use for seed beds in the very best possible condition, and let it be a light sandy, friable, rich, good loam. After the seeds are sown in the month of May, they must be shaded by using evergreen brush over the beds to protect them from the birds and from the direct rays of the sun, as the young, tender plants are very sensitive to heat and direct sun rays and need the same protection

THE PARENT TREE OFFERS THE YOUNG SEEDLINGS.

After being grown here with all possible care for one or two years, they are removed to other and ampler grounds and planted in nursery rows, one foot by three feet, and allowed to develop themselves there for from three to five years, or until they reach a height of 5 to 7 ft., and a diameter at the base of one-half or three-quarters of an inch through for all deciduous sorts. Of course evergreens will assume different forms of growth, and to get them up they must be planted at first quite thickly in the rows. It will be found very surprising how much can be done in this and similar ways in raising tree seedlings nice and fit for general planting. Even young people can experiment in this way on a small

scale and raise all the tree seedlings they may need for the farm in small plots in the garden devoted to these purposes, and many very fine and beautiful trees will be the result, that can be used for protection and further beautifying and ornamenting and enhancing the value of the farm.

I would not dare to attempt for a moment to offer minute directions in detail for the production of forest trees in large quantities to professional or old practical growers, but for the further information of others who are not so I may beg to offer the following observations: Trees grown in nurseries, in ordinary nursery rows, say three feet by one, will include 14,550 to the acre, and will be found to be so much superior in every way to forest tree seedlings freshly removed from the woods as to amply pay all the expenses of youthful culture. They will have better roots and rootlets, better bodies, and by far better tops, and will, in consequence of this early, wise and judicious treatment, in the open ground make altogether better trees and in far shorter time. I would therefore greatly prefer them even at a greater first outlay of cost. The next important consideration in the matter is about the plans and methods to be adopted for permanent plantations, and these will be found to greatly differ according to the ultimate designs intended to be reached. These designs may be classed under the three following heads: I. Forest-mass planting; II. Belt or wind-break planting; and III. Ornamental or beautifying planting properly so considered. I will try to deal with each of these methods of planting and as briefly as possible.

I. FOREST MASS PLANTING.

I will suppose the ground to be well and carefully selected, rich, and an ordinarily good productive soil, the nature of which may vary as well as the extent of the surface to be covered, from one to twenty-five or even fifty acres. This ground must be thoroughly well tilled and friable, not too wet or too dry, and in every way good condition to be planted in the spring of the year and as early as possible. After taking the proper bearings of the piece it will be well to lay it out so that it can be planted in long straight rows three feet apart in every direction, so as to include 4,840 trees to the acre. The trees I would prefer young, and not too large, say from four to six years, according to the kinds used, to facilitate as much as possible the work of planting. This work may be done by means of an ordinary spade, one man making the holes to fill the others up as the other man places and holds the trees in proper position. Two men in this way will plant from five hundred to one thousand trees in a day by using diligence and skill in their manner and work. Perhaps it will be objected that this distance for the trees mentioned will be too close together, but it will be found of great practical advantage in actual culture in keeping the ground cool and moist and free from weeds, and also in urging the young trees upward instead of making so many side branches. After a term of years and the young trees have grown much so that they are now crowding each other too strong, the whole block may be gone over and take out every other tree in every row so that they now alternate and leave the spaces six feet apart to every direction or 1,210 trees to the acre. The remaining 3,630 trees taken out will be utilized for binding poles, hoops, withs, and several other purposes. After a longer time another thinning may take place until the trees are finally left about 30 feet apart, or 50 trees to the acre; but this arrangement may not at all engage the attention of the original planter. The questions of culture and pruning, etc., may depend upon circumstances and may be more or less as interest and disposition may dictate, but in all cases we would most decidedly be in favor of indefatigable attention and culture during all the younger years of the life of the trees. It

will help to make better and thriftier trees, healthier and better rooted, and, in short, it will pay. These blocks of beautiful young forest trees of either walnuts or butternuts, or hickory or chestnuts, or basswood or tulip trees, or ashes, elms or maples, or mixtures of all these in certain proportions, we do most earnestly hope to see established over the face of this country to greatly add to its native beauty and to its still greater intrinsic worth. Who would like to see their country degenerating into a great waste desert, or even into a bleak, open prairie like those treeless regions of the great North-west? We are as naturally bound to our trees as the heart of a child to its home, and can no more easily bear the thought of living without them. A young man of our acquaintance leaving this interesting country went away west to settle on the open plains of the Dakotas. After passing some six or eight years there and the sight grown unfamiliar to the pleasing contour of his home trees, he was induced to travel on an excursion about fifty miles from the point where he was to see the broad Missouri river and its richly tree-planted valley in their beautiful proportions. The thing that took his attention first and most was not the broad, calm waters of the river or its majestic flow or its astonishing and awe-inspiring length, but the trees bordering it and filling its valley. He exclaimed, "How beautiful those trees appear! I think I should never tire to look upon them. They remind me of the beautiful forests of our native Ontario, and I have seen nothing like these since I left home." This no doubt an index to the feeling that attaches every native of Ontario to his forests and his native trees.

II. BELT OR WIND-BREAK PLANTING.

This form of tree planting will also greatly depend in its extent and form upon the ultimate designs or plans of operation. If the belt is intended merely for protective objects and is made to include the orchard or the garden or the dwelling for the family, or a small block of ground for other purposes, then the plan of operation is very easily determined. Good wind-breaks may be formed by using evergreens and placing them round the block at distances of six to ten feet apart, or better, at distances of ten to twelve feet, and double the row so as to break spaces. This will no doubt make a cheap and very efficient belt for the purposes designed. It will be found better also to give some protection to those young trees and considerable culture and training while they are young, otherwise their form may be injured and their growth retarded to a very serious extent. A very efficient and handsome belt may be made by taking a wider piece of ground, say three or four rods around the piece to be enclosed, and planting high-growing, deciduous trees on the outside and then nearer to the centre high-growing evergreens and lower growing deciduous trees and lower evergreens, and so on, till the allotted space is filled. This is a faint effort, as the two objects to be aimed at, viz., the ornamental and the useful, which, of course, is not an objectionable combination. Belts again may be planted even without much design of plan around any particular field, or even around the whole farm, by placing trees along the lines and divisions, ultimately to grow up to large trees; and they will be found to be very useful and add very much to the real value of the farm.

III. ORNAMENTAL OR BEAUTIFYING PLANTING.

In this department I shall not descend to particulars either in operation or description, inasmuch as it falls directly within the province and art of the *Landscape Gardener*, who, as a general instructor, must be consulted in all matters pertaining to it. But still, lest some should by this remark be discouraged

from all attempts in this direction, I may be allowed to say that so much is now being published not only upon this special matter, but also upon all ordinary matters pertaining to the farm and its improvement, that any ordinary person of ordinary intelligence and skill may in a very short time pick up much that will be useful to him and enable him to do things that could not be thought of a few years ago. I would say then, let none be discouraged by any means, for if you have not the means or are not disposed to hire a first-class, professional gardener when you want to plant trees, use your own acquirements and do it yourself; you will learn much as you go along. The size, location and general surroundings of the block will serve to guide you much and the general effect which you intend to attain must also be consulted.

ARTICLE ON EXISTING PLANTATIONS IN CANADA.

BY T. M. GROVER, ESQ., NORWOOD.

Our readers are here given the statements of a gentleman who can speak well as to the results of plantation in Ontario, he having established, and now for some years cultivated one of the largest private plantations of forest trees in the country. It is of great value for this reason, that the writer does not disguise from us that he has had several failures as well as many gratifying successes. Concerning his failures, he gives us frankly the reason that in some places the trees were not suited to that part of the country; and in others the land or the subsequent care of the plants were not precisely what they should have been. On the whole, however, his experiences are very encouraging, and give valuable warnings to those in that part of the country as to what trees they may safely plant or not. When once a number of these plantations begin to stud our land, and those young trees, which are valuable when only six or eight inches through, begin to sell, there will be planters enough, and many will regret that the intervening time was wasted—that they did not in fact plant now. I have repeatedly laid before my readers statements from the owners of large wood-working manufactories to the effect that they would often be glad of the opportunity of purchasing large quantities of young timber of this class. One firm near Kingston I remember saying that a hundred acres covered with young hickory would be more valuable than all the crops produced by several adjacent townships. My readers, who may have observed the slow progress made in growth by a hickory, ash or other tree growing in the open, would find these trees if grown in plantations of a good size, say an acre, grow in quite a different fashion. Let us plant them say at four feet apart each way so as to give space for cultivation for a couple of years to keep down weeds, and they will grow up tall and with few branches, giving long straight sticks, pretty clear of knots, and yielding far more valuable timber than could possibly be cut from any natural hardwood forest. Of course, after a number of years, these will need thinning out, and by that time in most regions of Ontario, even the thinnings will be valuable.

Mr. Grover does not approve of the attempt to raise trees from seed in Ontario, thinking they had better be imported from foreign or bought from our own nurserymen, and rather doubts that in case of the conifers, they can be successfully raised to any profit by amateurs at all. In actual practice, however, we find this different. Captain Twohy, of Hamilton, having some leisure, amused himself three or four years ago by raising in his own garden 350,000 fine plants of the Norway Spruce, as difficult a conifer, perhaps, as there is to raise from seed. Of course this involved the necessity of complete shelter and proper supplies of fresh air and water at necessary intervals. As to the general amount of tree seeds sown through the country, it should be remembered that it is not always the strong men in the family who are likely to busy themselves with seed sowing. In many cases I have known it was the old man, the owner of the farm, who, too weak now for active labour, found employment and amusement both in raising from the seed tiny rows of plants, and also transplanting them when ready into a nursery bed, and then again in the places where they were ultimately to stand.

Mr. Grover has had difficulty, it appears, with the nut-bearing trees, especially with walnuts, but has not got into the right track. Let me repeat what has been stated in most of my reports, that these had better be kept through the winter in heaps covered with litter or in sand made occasionally damp. Many of them will sprout in spring, and these, properly planted, are generally a success. I may remark here that I have known walnuts brought from Kentucky most successful in germinating near the lakes.

In another communication Mr. Grover makes the valuable remark that, "There are many good farms in every county in Ontario in the possession of old people, of females, of trustees and of tenants, and of which proper profitable cultivation is not possible at all times, but which would steadily increase in value if part was planted to timber, and at a future day would be of greater value than all the income that could be derived from it in the meantime. Forestry is a science; we have not come to that yet. The relation of each tree to the whole forest, the shade-enduring and the light-needing, the rapid-maturing trees, the nurse trees, the short lived-trees, the study of a century of growth, survival, influence of each variety on the other and on the soil—in fact the whole subject of national forestry—will soon call for ardent students, and every step on the way will, we hope, be of profit and encouragement to the individual and to the country."

Mr. Grover goes on to say:—

SEEDLINGS OF MY OWN RAISING.

An evergreen seed-bed I found a great trouble and a practical failure, and the idea of suggesting the raising of any conifers from seed by beginners particularly unfortunate. In this climate the unusually tender seedling of all conifers requires protection varying daily, the little transparent shoot less than an inch high will wither in one day's sun, or will rot or damp off in two days rain, and from birds

and mice a wall must be provided to protect them. I find nurserymen in Canada generally avoid planting evergreen seeds, and many prefer to let the seed of all the trees alone. In the moist open air of France and Scotland there is no such trouble as we find here. When the business is done on a large scale shelter, proper soils, ventilation and proper supervision can be given to millions of plants as easily as to a hundred.

My seed-beds were never entire failures, and if I followed up seed planting I think I could obviate most of the difficulties and no one need hesitate to try it for the purpose of experiment, even if there is a cheaper way of getting the trees.

I sowed in the fall of 1886 and in the spring of 1887 all common varieties of tree seeds, and at this time the best of them being now three years old, they are about as follows:

Black walnut.....	4 feet.
White ash	5 "
Yellow locust.....	8 "
Mulberry	4 "
Soft maple	4 "

Conifers:

Larch	12 inches
Scotch pine.....	9 "
White pine.....	7 "
Norway spruce.....	5 "

The catalpa, mulberry and locusts are of doubtful hardiness, especially the first year or two, and a careful selection of northern grown seed is indispensable. The locust must in all cases be covered the first winter, in fact taken up and stored or most of one year's growth will be lost, and for want of this the size of my best trees is not a criterion of what three year's growth should be in this climate. The mulberry is not really suited to planting in this climate, although it does succeed in as severe latitudes; the seedlings are uncertain—one may be hardy and the next tender, and it may well be left out of the list of trees desirable for us.

IMPORTED SEEDLINGS.

A good many trees of all varieties and from several of the largest American nurseries have been set out each year both in close rows and in the plantation. I found a good deal of trouble in both systems, although small seedlings can be bought for fifty cents per thousand and a bushel of ash seed for one dollar, yet for the sake of a thousand good trees obtainable freely "Two year transplanted" at from three to ten dollars per thousand, it will not pay to prepare land, plant the seed or seedling, hoe, cultivate, and transplant at a busy time; in fact it is worth the nursery price to dig and sort them, and the whole of such work is much better left to large establishments where skilled men plant and dig by machinery at just the right time, sort into sizes (for like vegetables no two of the same planting will be alike), count, store and ship in lots more easily than I could do any one of the operations. My experience is that the amateur planter can well do, as I find our small Canadian nurserymen prefer to do, buy what few trees they need from those whose business is so large that the items are very small. In many cases they will ask but one dollar per hundred, and for a thousand one and-a-half dollars! The small price asked need not lead us to think that all our American friends will send us only wild seedlings pulled out of some

wood or marsh near them. They say there are some who do—but the responsible nurseries do not need to do so, and I can bear witness to their general care and responsibility, their interest on small orders, as well as large, and very often their promptness to replace failures, not always traceable to them.

SEEDLINGS' CULTIVATED.

Now for two or three years show a growth as follows :

Black walnut,.....	3 years growth, 3 feet.
White oak,.....	" 5 "
American elm.....	" 5 "
Box elder.....	" 8 "
Silver maple.....	" 4 "
Norway spruce.....	" 3 "

At the same time many walnuts and nearly all the catalpa, sycamore, mulberry, coffee trees, and larch, though doing well, do not make a great yearly increase in height. The removal of all except the maple, elm and ash, seems to retard the growth for a whole season, in all sizes of the tree, and this must not be overlooked in planting any large number of trees.

NATIVE SEEDS AND SEEDLINGS.

My experience is that three years' additional growth will add to small seedlings as follows :

Sugar maple.....	3 feet.
Soft maple.....	3 "
Basswood.....	4 "
Black cherry.....	4 "
Elm.....	5 "
Black ash.....	3 "
Oaks.....	2 "
Cedar.....	2 "
Tamarac.....	2 "

It will not take half-an hour in many of our woods to gather 500 seedlings of any of these varieties, except oak. They are so easily and safely removed and so sure to grow rapidly, that it is a pity people who want to plant trees will always leave it till the last minute, and be obliged to take a crooked stick because it is the right size.

The oak is a greatly neglected tree, partly from the impression that it is a slow growing tree, and also that it is hard to transplant, both of which ideas are now contradicted by leading nurserymen in the United States. The acorns are more easily got than seedlings, and very certain to grow, and the seedling so very tough and with such a firm root, that it is a most satisfactory tree for planting, whatever may be its possibilities for profit. Plenty of seedlings of the black oak can be found, and I believe it will grow on dry sand where it will be hard to make other trees survive.

PLANTATIONS.

Simple as it seems to have a field prepared about as for wheat, and mark it out for planting 4x4 feet, and being supplied with seedlings from a nursery, send a man and a boy to plant two or three acres a day, then to care for it as we would for corn for a couple of years, I venture to say that persons without previous experience will find it rather more easy to fail than to succeed, and with the best care there are inconveniences if not difficulties.

I found the named seedlings came to me in bundles, but were mostly about the size of a knitting needle, and at four feet apart, it was hard to follow the row with the eye, especially white ash, which often will not show a leaf till they are six weeks planted. Another lot of seedlings came duly, but the bundles had broken apart, and I could not then tell ash from elm or buckthorn, and could only put them in nursery rows till they developed. One lot of ash proved not hardy and froze off to the ground every winter.

I think for beginners too, one variety of a tree at a time is enough, for there is no particular object in providing other kinds at intervals to be cut out, leaving the main stock only to mature. For instance: a lot all white ash will be more even and easily looked after than if mixed with slower or faster growing trees.

LARGE SEEDLINGS.

For every practical purpose of forest planting here, I recommend, for the inexperienced, the use of large or two year old seedlings only, which will be about the size of a riding whip, and for the first block stick to one variety. I would not limit a nurseryman or gardener experienced in handling trees to size or variety however, for the little seedling will grow all right, and, no doubt, a proper forest growth is best attained and only perfect in a mixed plantation. There is no object in getting the smaller seedling because it is cheap, and trying to develop it in a nursery for a year or two. The labor of planting any seedling is greater than the wholesale cost, and to plant, cultivate, transplant, and set out again for the sake of three dollars a thousand, is loss both of time and money. Where the seedlings of common forest trees, ash, elm, maple, cherry, and the like, are sold at one to two dollars per thousand, the price asked for two years transplanted of the same variety will be from five to six dollars. The only real difference is in the cost of handling, the two year trees always having a root requiring a hole to be dug, when the small seedling will not need more than the work of the spade. I did not find the two year old any more difficult to establish, and the time saved is encouraging.

OTHER FAILURES.

If I have met some small disappointments, I have many reasons to feel encouraged when I read of the plantation of Mr. B. Landreth, in Virginia. This gentleman, who is the large dealer in seeds in Philadelphia, some eighteen years ago, undertook to establish 5,000 acres of forest in Eastern Virginia. If that had been successful it would have been a noble forest to-day, but Mr. Landreth was obliged to report at the last American Forestry Congress, that the plantation was a practical failure, although I have no doubt he had employed all the skill and forestry experience available for material, as well as the work. The walnut is a grand tree in the native forest in that region, but made feeble and uncertain growth when cultivated. The pines and other conifers refused to grow. The nuts planted, and the seedlings of other nut-bearing trees, were injured by rats,

squirrels and cattle. The locust, of which at one time he had a fine block of over fifty acres grown to a good height and with interlacing branches, which shaded the ground and averaged six or eight inches in diameter, were destroyed in one year by the borer, and it cost him quite a sum to get rid of the stumps, and as a final result, only two trees can be said to have succeeded at all—the catalpa and one of the hardier spruces—yet the owners intend still to prosecute the work. It may be the protection of a few good trees; or a different system will give the necessary experience to insure the success of this most interesting attempt at the very work we are all talking of. The failure there of trees which seemed to grow so well in the nearest forest, is remarkable, especially as further west in the same latitude, but in a drier situation, in Southern Ohio, all the same trees seemed to do so well. There seems to be little trouble here, in Canada, in raising any tree that will endure our winter. Some of our most careful planters tell me the sugar maple is very uncertain and a slow grower when transplanted; but I have not known many of them planted when of the seedling size, and, of course, larger trees are always uncertain. In my own little nursery, all our wild seedlings grow easily; maple, perhaps, a little slow, but nearly always successful, and when once really established, seems a very durable tree.

SUCCESSFUL PLANTING.

In the case of trees requiring some exact experience, perhaps in every locality it will be necessary to make a trial before we can say just what variety will succeed best. The result of my planting so far, is that I can now feel confidence in planting any number of the following trees in the ordinary farm land of the central counties of Ontario, and I mean generally the ordinary seedlings most readily obtainable from nurseries.

White ash, black ash, box elder, black cherry, white elm, rock elm, yellow locust, sugar maple, catalpa, basswood, cotton wood, Scotch pine and white cedar; with more care, the black walnut, white oak, hickory, spruce and white pine, are easily established, but are a little slower to grow and do not so easily keep out of reach of the weeds.

I mean such planting to be ordinary cultivation only; without any watering, mulching or protecting, in fact, not more care than could be given to a plantation of any size one wished to establish, and with sufficient attention to keep down all weeds.

In Scotland and the north of Europe, where many forests are being planted, the climate is so very different that trees are more easily established. They can make the Scotch pine grow by simply cutting a cross in the sod and turning back the corners and sticking in the seedling, and the sun is never hot enough to wilt it. The pines and all other conifers here, either require, or at least are greatly benefited by a covering of any kind the first year, and to be planted firmly in a moist soil; the drying of the roots either in transportation or planting, being especially injurious.

The choice of variety of our ordinary deciduous trees is not at all material to the success of the plantation. We may be influenced only by rapidity of growth if that is an object above all things or the ultimate value of the timber the mature trees will furnish for sale, or the greatest amount of protection from sun and wind, that will be furnished in a short time.

The white ash seems particularly adapted for general planting here, and is my first favourite if I was required to choose. The firmness of the wood and bark and clean straight growth, are attractive at all times, and its quick growth

and usefulness at all ages are well known. The seedling of box elder resembles it very much, but while young it branches and suckers too freely, and I am told the mature tree in the west resembles a big apple tree more than a forest tree, but it is a very handsome and useful tree, and so cheap and easily planted that it will be long before we have too many.

The black cherry is good in every way, and a very rapid grower, but is sure to be stripped by the caterpillar. I don't know whether the tree would suffer in the middle of a thick grove. The cherry is said to grow twice as fast as walnut, and will endure being planted much more closely.

None of our native trees, when of good size, grow faster than the rock elm, and it is always a valuable wood; it is not quite so handsome as the white elm, but all the elms are so liable to the attack of the leaf beetle, that it is not now so generally planted.

The locust does not seem to suffer so much from the borer here as it does further south, and as it grows so rapidly, and is said to be as good firewood as maple, and better than cedar for fence posts, as well as useful for manufacturing purposes, it seems a most desirable tree for trial generally.

ONE VARIETY ONLY.

While arboriculture is experimental, I strongly advise the planting of only one kind of tree on a plantation. There are so great variations in development in different soils, that unless in the hands of an experienced planter the growth will be very uneven—one tree might do well where another will hardly hold its own, when under proper circumstances they would do very well together. A small lot of all ash, or all cherry, or all maple, will furnish a greater return and a better test than if all were mixed. I do not speak here of a proper extended planting under skilled management, where, of course, all kinds may do well, but of small lots under the management of those unacquainted with the trees and their growth in detail.

FOREST SEEDLINGS NOT SOLD

by Canadian nurserymen as yet, must be got in the United States. Many advertise in the common agricultural and horticultural papers, and an order for one or two dollars is filled just as carefully as any large one, and as prices in all cases are quoted at wholesale rates, and the stock carefully packed, and no duty, neither price nor distance need hinder us planting trees.

PRESERVATION OF WOOD LOTS.

While so much has been said to encourage tree planting by farmers and owners, the care of the remaining trees on the farms should first have our attention in the interest of forestry. That a few trees, irregularly growing on nearly all our farms are evidence of some thought on the subject, yet that no wood lots have been effectually preserved, at least I know of none, is a matter of regret to every student of forestry. We have one block of 100 acres of fine hardwood bush of nearly all old trees, so effectually pastured by cattle that it would be impossible to find one tree small enough for a handspike in the whole of it. The large timber nearly shades the ground, and every spring the whole surface is covered with a growth of seedlings of three or four inches in height and including every variety of native tree, but destined to afford only a poor pasture for wandering cows.

Another small block has been enclosed for about ten years, and for many acres on the south and east is already densely wooded and almost impenetrable; many maples, elms, basswoods and cherries are now ten or fifteen feet high and will soon be the best forest left.

Another block now four years fenced in with the ploughed land is entirely covered with an undergrowth from two to six feet high, and if it can be preserved long enough these will replace the matured or maturing trees now fast passing into decline and decay. Farmers should realize the little good of the pasture of the forest undergrowth, one acre of mixed grasses really affording more feed than twenty acres shaded bush land. Since the introduction of wire fencing it is easy enough to fence off the portion of bush desired to be preserved (do not twist the wires round the trees, but fasten them to a slat nailed against them); this will preserve the bush, and it is very dear beef that is grown by spoiling a good bush lot. In all my wood land, more or less isolated blocks, the number of old trees which are already dead at the top would astonish any one who counted them. I am led to believe that the preservation of a native forest requires more knowledge of the principles of forestry in theory and practice than a new plantation. Professor Fernow, Director of Forestry in the United States, seems to say the same. A cutting out of the matured trees may or may not be proper—a thinning of any kind or of any proportion of the surface of the land may or may not tend to the best development of the whole. The extension of the grove by outside planting, and in fact any effort to make it a permanent forest, will tax the best skilled forester. Cases are mentioned where the cutting out of an inferior kind of wood, as of rough swamp elm, has so deprived the good growing trees of the needed protection from sun and wind that the result was soon seen to be disastrous. A clearing out of old logs and undergrowth, as practised in a park, would be ruin; the ground needs the mulch of wood and leaves above all things; in fact without the aid of science protection is the only thing that can be recommended.

THE STUDY OF FORESTRY.

Any person giving attention either to the growing forests or to the forests now being cut away will soon feel there is a good deal to learn. Few in Canada are aware that there is a science of forestry and that books have been written and generations of men trained to develop forestry in its minutest details. That each variety of tree must be cared for in special manner—each requires in a different degree light, shade, moisture and protection, by its own kind or by others. The period of maturity of each is varying as well as the further duration or rapid decline. After this the effect of forestation on the adjacent land and on the climate and health of the region will be of interest to the observer and of profit to the community.

On the Otonabee River, where most of the pine was removed about forty years since, one block of 200 acres had been kept untouched till last year. No doubt the owner had his own trouble to resist the offers of lumbermen to cut that in almost every year; it was on the bank of the river and convenient in every way. Two or three years since, the gradual deterioration as well as the slight growth of the trees became very noticeable, and it was evident it must soon be cut to save it, and the owner then sold it at fifty dollars per acre for the pine alone. If carefully and scientifically examined, I have little doubt it would have been found to contain more sound wood a few years before, and it is, I think, a good illustration on the subject of forest preservation.

LUMBERMEN'S FOREST LORE.

The clearing of our forests, now almost entire in the settled parts of Ontario, will soon drive the lumbermen entirely to the north and with them a large experience and skill in one branch of forestry will disappear—I mean economic forestry, or how to make money out of trees. It will take a wood ranger many years to be able to go through a forest, and by counting the trees he can identify without changing his stand to say how many merchantable trees that grove can be depended upon per acre he can also tell by clasping his arms about the trunk; if the tree will yield a piece of timber a foot square or not. I think this kind of knowledge is limited more or less to America, and that a German or other trained forester would rather make exact measurement and calculations, and I doubt if he would be as nearly correct.

An old lumberman, my neighbor, has at times said to me, "There are three rock elms and one black birch in your woods that make timber, what will you take for them?" When I must admit that it would take me weeks to find them on a diligent search, a life long experience with woods must it is clear, give a knowledge of the subject which no scientific training can equal.

FOREST LITERATURE.

The student of forestry will find that the subject has been well discussed in the present and in past writings. Apart from botanical works there is a whole literature of American Forestry as well as European. A new periodical, *Garden and Forest*, gives us the latest and best views of practical tree planting and forestry. *Fuller's Practical Forestry* and *Hough's Practical Forestry* are useful American treatises and good practical instruction and general information are found in Mr. Phipps' reports to the Ontario Government. General Brisbin, A.S.A., has lately written, "Trees and tree planting," evincing an interest in the subject, M. H. Eggleston, hand book of tree planting; Geo. Pinney, Culture of Forest Trees; and the forestry reports of the American Government will be found of great interest, especially those for 1884, 1886 and 1888.

NATURAL FORESTRY.

The general work attempted by some foreign governments is of great interest to many students of forestry, especially the efforts made in the United States where the conditions are so similar to our own. The surveys there made and the estimates of the existing forests are of little value—it is almost impossible to say the existing forest of a locality will be used up at a fixed time, or to judge of the future use by any estimate based on the past. In New Hampshire the entire removal of the pine was predicted for a time now past, though they are still lumbering there. It is quite true they are now cutting into boards pine trees of four inches in diameter, but I take it this is evidence of more difficulty in transportation to that particular point than of the end of lumbering operations in the State. On the Pacific coast the lumbering was long confined to land on floatable water, and there may be lumber exported there long after its apparent supply is ended.

But the survey and investigations are a necessary part of the subject as well as the planting of new forests and the condition of the prairie region.

The schools of forestry in Germany and England, the forest regulations and development of India, the study of the use and durability of woods as applied in the construction of railways and in the arts and manufactures of the country are a necessary study for Canadians hoping to adopt any forest policy in the lands we are interested in, and the application of any part of a forest policy before it is too late must be undertaken now, while we can still study the old and establish the new forest at the same time.

That reforestation on good land will not be profitable is no standard by which to fix the forest policy of a country, but the results of plantations in Europe and in the east, and the protection and well regulated sale of the timber in Indian forests (Hindustan) judged by the timber alone and disregarding all scientific and theoretic benefits of forests, are sure to encourage every community in America to admit the propriety of, if not to adopt a system so earnestly to be desired.

ON PLANTING TREES AND HOW TO GROW THEM.

BY J MCP. ROSS.

If those who receive this report will carefully read the following article by Mr. Ross, (and it would be all the better, unless they possess specially good memories, that they should read it once or twice over again) they will find much to admire in the clear and easy style in which it is written and much of profit in the valuable instruction given. It is not, they will notice, written in anything like dictionary form; here and there they will find a piece of instruction well worth remembering, here and there a reflection equally so. Mr. Ross has had, as he tells us, twenty-seven years' experience in practical tree growing, and also the great advantage of passing much of that time under the supervision of one of the oldest and best planters in Ontario, Mr. George Leslie. During that time, of course, he has had many opportunities of observing both the failure and the success of different plans, and it may be observed that he says little or nothing of failures now, knowing, apparently, well how to avoid them. But one point concerning this should be particularly noticed, that is that without proper care both in the preparation of the ground, the planting of the tree, the time for planting and the keeping the ground free from weeds afterwards, he appears to consider that failure might very well result.

Mr. Ross mentions the large forests of pines and other evergreens which we still possess. But these, unfortunately, lie mostly to the north and east of cultivated Ontario, while to give their principal climatic benefit, the condensation of clouds, production of seasonable showers, and restoration in fact, of our former Canadian climate, they should be to the south and west. To these positions, of course, we cannot restore their former pine forests, or the great hardwood forests once intermixed with them. The land was rich and needed for agriculture, and has mostly long been cleared. What we can principally do in this matter is, throughout older Ontario, to preserve what still standing forest we may, to clothe

with trees our thousands of barren hillsides, to plant where needed a wind-break, where possible a good plantation, and we may then hope to experience the once pleasant and fruitful climate of Ontario again. More of this planting is, in fact, being commenced of late years than my readers might fancy. but very much more is necessary.

Another point Mr. Ross notices is worthy of particular attention. For want of its observance I have known weeks of labour and whole seasons of time completely thrown away, that is to say, the keeping of the roots of evergreens in a moist condition from the time they are drawn or dug from the forest bed or nursery plantation till they are safely planted. The best way in which I have known this accomplished is having the waggon close by, putting the trees in with a considerable lean backwards, and packing plenty of damp moss, or something of the sort where that is not obtainable, round each root, having a large tarpaulin or canvass lying loosely over what you have packed in, and when your load is complete tying it over the whole. I remember bare fields near Toronto, of some acres in extent, which were planted in this manner. Not a tree was lost and they are now beautiful little pine forests, I should think over sixty feet, in height.

It may be also useful to remark that it is better, unless taken very young, not to take young pines from a very deep sandy soil, as their roots will be very slender and so deep as hardly to be taken up without breaking.

With reference to Mr. Ross's suggestion of a thick border of trees round each field, I should rather approve of his other plan, namely, a good plantation to each farm, so placed as best to shelter it. One thing is certain, however that if Ontario is to be, instead of a wheat-growing country, a grazing and fruit-growing one, we must again have our former rich crops of grass, and we cannot do so without we plant many more trees :—

PLANTING TREES.

By J. MCP. Ross, Esq.

Looking back on an observant period of twenty-seven years practical tree growing the writer has many things to regret. The greatest regret of all is, however, disparaging, as they are commonly called, tree peddlars : and advising or discouraging people and acquaintances generally from patronizing the class as a whole. Why ? Because the writer was aware of the many frauds and impositions practiced upon the guileless public by the unscrupulous pedlars, as he then thought them to be, and also influenced by nurserymen's sayings and writers generally on tree subjects, against them.

Now I very much regret ever having any animus against them, for had it not been for their zeal, overzeal, enterprise and cheek, or whatever you may like to call it, many places now blooming like the rose would have been as barren almost as the sandiest place in the Sahara desert. To plant a tree is a benefaction to the public—to make it grow shows care and observation on the planter's part, and is deserving of great credit—but to induce a person to plant who would never have thought of it at all, no matter what it is they plant, whether hedge or

shelter belt, pine or fruit tree, flowering shrub or rhubarb plant, is a good action, and whether the reward is in his own satisfaction or is a highly remunerative one it does not matter, for future generations should rise and call him or them blessed.

Then all honor to that abused class for the good work they are doing, no matter where they come from or of what nationality, whether Dutch, Yankee or Canadian, let them sell to the public in all the length and breadth of the land. But now we must say do not do it unscrupulously—do not sell a man a magnolia where a horse chestnut will not thrive, but do your business intelligently; learn the business, tell the farmer or the planter what trees may and would thrive, tell him what is best to plant at the present time on his soil, on his location, and in his particular latitude.

I know the blame often falls on a tree agent from the carelessness and neglect of the planters themselves, who will not give the attention necessary to success.

Careless planters are numerous and mischievous, for, by relating their bad luck, they often discourage careful people from planting, who would have been successful had they attempted it.

Before going into my main subject let me say a word of praise without vanity or flattery, all honor *Firstly*, to that government that recognizes the *vital* importance to the country of tree planting and diffuses such information as will stimulate and direct farmers to grow successfully fruit trees for their gardens and forest trees for their woods, whether evergreen or deciduous, either native or imported, that will give beauty to the landscape, moderation to the climate, shelter for their cattle and crops, wood for their firesides, and refreshing shade on roadside and in the field to the friend and the stranger. *Secondly*, to those enthusiastic gentlemen, whether professional or private citizens who, having the love of the beautiful and the useful in their hearts, do all they can by voice, pen and example in giving the benefit of their experience and observation to the public at large. But here a thought, is it not a gratifying pleasure at all times and in all seasons to the person who plants, to watch the growth from the tiny seed or cutting—from plant age to massive tree—to view with complacency in old age as Downing states “Those leafy monarchs, planted by his boyish hands and nurtured by him in his youthful years, which have grown aged and venerable along with him—

A wood coeval with himself he sees,
And loves his own contemporary trees.”

And now to our prime subject and the title of this article. I can point out this fact to any observant farmer or gardener or to any intelligent person, that nature *always* provides some expeditious method for the rapid reproduction of the species and particularly of the vegetable kingdom. Say first from seeds, second from cuttings, third from layers, and if not rapidly from either, at least from divisions of roots or green cuttings rooted artificially under glass. But fortunately for us, our principal valued forest trees grow freely without any difficulty and do not require any great skill, but the slightest observation and care. CARE, *care*, we must repeat, is everything. Everyone knows what results are gained in any business no matter what it is from the form of attention given it, and we can only utter the truism, *i.e.*, the best care gives the best results.

I hardly know what class of trees first to take up to give special importance to, but will rapidly glance at them all. We notice, however, that the old trees or varieties say grown twenty years ago are the leading ones yet, and although new ones are occasionally introduced they do not stand, say my twenty year test. So I will fall back on my old acquaintances in the following order. Nut trees ripening in the fall in their care and attention: Oaks, walnut, butternut, horse,

and sweet chestnuts grow easily and freely from the nuts gathered as soon as ripe in the fall and sown at once; hickory and the beech also grow freely, but are a little more impatient of transplanting; all taprooted trees are more or less so difficult.

Two methods can be adopted to grow them successfully, first to cut the tap root in the seed bed the first year, leaving the plant undisturbed either by spade or other sharp instrument; second, to bend the tap root in the space where the second planting is to grow permanently, and soft growing trees like the horse chestnut or butternut may remain two or three years in the seed bed, then being dug up can be assorted in two or more sizes, should be neatly trimmed to six or seven inches of root length and tied in convenient bundles for transplanting. The hickory is the most shy, but even it is easily grown when the tap root is cut in the bed, or as we say, semi-transplanted.

IN THE SEED BED

As before saying, sow the nuts of all kinds of nutbearing trees, as soon as possible after gathering—in good, rich garden soil, of deep tilth, in drills 18 inches apart, and in the drills say from 4 to 6 inches in depth. Have seed bed well drained, the soil on top anyway. A sandy loam that will not upheave by frost and when covering the soil evenly, tread it firmly, for, as an old gardener says, the foot is a better gardener than the hand. Do not neglect the tramping and finally, but most important, cover the bed with a good covering of manure, leaves or any other substance that will retain the soil and keep from exposure to wind or sun till the growing season commences. Carefully examine the bed now and then to observe when any signs of growth appear—then remove the mulch or covering, but not before. I may say the whole secret in growing nuts or other seeds sown in fall lies in the importance of thorough mulching. This also applies to the growing of plums, cherries and peaches from the pits or seed. Peaches are generally cracked by hand with nutcrackers and the kernels and shells left mixed in sand in some cool cellar till sowing time arrives. If not practicable to sow the nuts in the fall, then dig out a shallow pit and spread sand or earth on them, over that putting a mulch again. If this is not convenient then cover nuts in boxes with sand and place in shady spots of buildings or hedges to freeze and undergo the natural changes.

Still treating of trees that grow freely from seed, we come to the early-ripening ones which include all elms and soft maples. The time is generally about the 15th of June, the time of ripening varying a little according to locality. The general crop of seeds on elms and maples will be found ripe enough for sowing as soon as any are observed to be falling to the ground. They should be then gathered and sown in drills two inches deep and two feet apart. Select a spot partially shaded through the day—good, clean soil, well manured and deeply dug must be the conditions all the time to get a good growth the first season. If weather is very dry, water freely. The young seedlings, if all conditions are complied with, should make a growth at least fifteen inches the first year. They can be allowed to stay in seed beds for two years, when they may be removed, sorted into different sizes, the roots trimmed, tie in bunches and heel out plants at convenience; or they may be packed in a cellar till a suitable time comes for planting.

If not convenient to sow when gathered, the seeds may be kept in drawers or bags in a dry place till fall when they may be sown, but when sowing them again let me remind you of firmly tramping the soil over them—mulching will not be necessary in the summer sowing.

The trees that ripen their seeds in the fall are the hard maple, Norway do. ash leaved or box elder, buttonwood, birches in variety, ash in variety, basswood locust, wild cherry, alder, and mountain ash. They may be all sown at once according to directions for summer sowing with the instruction to mulch them well. The mountain ash should be bruised with a hoe, then wash out the pulpy integument as cleanly as possible, dry the seed and mix with sand and sow as before in drills in a partially shaded spot.

The pods of the locust may be gathered during fall and sown then or kept through the winter for spring sowing. This tree grows very freely from seed and very rapidly, and its timber makes the most lasting for posts or cellar foundations. The tree is a little late in leafing out in the spring, but when in full leaf is very beautiful and deliciously fragrant and charming when in flower. In winter the ragged dark trunks and branches of lighter color make it decidedly picturesque in appearance.

Of the colors, season of leafing in spring or other peculiarities, I shall speak further on and will still keep to the propagation feature of my article.

We have spoken about varieties principally to be raised from seeds. Some I have mentioned are easily raised from layers in seasons when seeds are not abundant. To do this what is termed a stool ground is necessary where trees such as the basswood or linden, alder, tulip and others are planted say five feet apart each way. After planting in the stool ground the original plant is cut to the ground and the young shoots or suckers that grow up immediately are bent down with a little twist or cut of a knife and soil covered over the cut with the top appearing out of the soil, now weights such as bricks or stones can be laid on the top of the soil to hold the young layers in position. After a year in this state they may be lifted and found ready rooted to be treated as young trees, trimmed and planted in nursery rows for future transplanting. The parent stool will again grow out, when another crop of young shoots will come again for layering and so on.

Having spoken of the layering system, I now come to the classes of trees to be readily propagated by cuttings from one and two years old wood. In this class we find all the poplars and willows in their different varieties, besides mulberries and numerous small growing trees, or perhaps more properly speaking, large growing shrubs, such as elders, syringas, etc.

THE CUTTINGS

are gathered after leaves have fallen in the fall or during the winter season any time. Make these into one foot lengths with a sharp knife or axe, observing always that the top buds are kept upward in their natural position, then after making tie up in convenient bundles for handling—bury in sand or sawdust either in cellar or outside in a pit dug for the purpose covered with soil first and straw second to keep from freezing, or better still, plant in rows in the fall up to the top bud and afterwards mulching.

This is an expeditious way to propagate all the willows and the various poplars. For reclaiming a hillside cuttings could be pushed into the banks, here when growing they would prove valuable in protecting banks from slipping down to winter frosts, besides giving shelter to other trees. Especially EVERGREENS, all of evergreens we cannot say too much in praise of their usefulness. Canada is essentially the home of the most valuable evergreens. Much of the early wealth and present prosperity of the country may be attributed to our extensive forests of spruce, cedar and hemlock. But that phase of the subject has been discussed frequently by abler pens than mine, and I will now draw attention to the methods

of propagating and transplanting. So many are to be found in swamps and other places self-sown and in such abundance that it is hardly necessary to speak of propagating them from seed. This is easily done but requiring such a system of partial shading, watering, and airing, that the average amateur had better buy small plants from those who make a specialty of growing them. Were I confined to grow one class of trees alone I think I should choose the evergreen family. It is exceedingly interesting to study the habits of the individual varieties, whether pines, spruces or cedar. They vary so much in the colour and formation of the foliage; and how extreme is the difference in the appearance of the bark from the smooth, shining covering of the young plants to the bold and rugged exterior of the monarch pine on the high cliff side, with its gnarled branches tossing its tasselled plumes in defiance at passing gales or gently sighing in the summer breeze. Our native trees are all more valuable than any imported strangers though we could not well spare the handsome Norway spruce, or the useful and picturesque Austrian and Scotch pines. The former is invaluable for hedges and screens while the others are equally valuable for those purposes, as well as being planted singly for adornment. When procuring young evergreens from neighbouring woods choose a damp, cloudy day in the latter part of May. Whether pulling them up by hand or digging the plants up with a spade be especially careful not to break the roots and to avoid exposing them to the air and sun as much as possible—packing them tightly in boxes with damp moss or other litter. When planting them assort the varieties by themselves, such as the pines together, cedars by themselves and the spruces; dip the roots in thin mud and plant about the same depth as they stood formerly. Evergreens should grow as close together when young as possible, as their foliage keeps the soil shaded and moist and prevents the trees from a too boisterous acquaintance with the wind till they have made some growth and become established. From the nursery row they can be thinned out alternately, leaving those that stand to become larger, and what you take out can be planted where they are to stand permanently, whether in groups or in hedge rows or shelter belts.

Trimming or pruning trees may be done any time after the first of July to the first of September. I mention this time particularly as during this season the sap begins to thicken and turn into wood, the edges of any cuts become calloused or partially healed over, and at this time a person may observe the trees to increase in diameter, and notice the formation of the new bark by the divisions and corrugations of the old bark. At this time crooked trees may be easily straightened by bending this way or that, according as the direction of the crooks. Crotched trees may be made to have one leader, by tying the two leaders together firmly at their strongest part, and cutting one leader back to within a few inches of the tied part, leaving the straightest leader. The following year the spur may be cut off, and you will find a comparatively straight tree with another year's growth. Tall, weakly or spindly trees, with irregular misshapen tops, can be made stocky, shapely trees, by cutting hard back in the fall. Wonders can be done even on trees twenty-five to fifty years old, by cutting back the old tops. Old country people are quite familiar with pollard beeches, ash, and many trees that are cropped every few years for their branches, which are applied there to many uses. To sum up generally, do not plant evergreens and deciduous trees indiscriminately, but plant each by themselves—(deciduous trees are those that drop their leaves in the fall)—each variety being impatient of the shade or drip of the other. I omitted to speak before of the larch or tamarac as useful a tree as a farmer can have on the farm. Our native variety furnishes heavier and tougher wood than the European larch, but is not any more durable besides not near so rapid or as straight in growth. A row of European larch

on a farm is a valuable acquisition. From it, in a few years, you may get any sized binding or reach pole, fence posts or building rafters you might want suitable for sheds or other structures. The young plants should be planted in the fall or first thing in spring, when the frost is out of the soil; to succeed well, as it starts to grow early, you cannot plant it too soon; otherwise, if left too late, it is rather an uncertain grower.

The care required to grow all kinds of forest trees is simply the same as to grow a corn crop well. Keep the weeds down and the ground well cultivated between the rows, plough up well the last thing in fall, leaving a deep furrow between the rows of trees. One thing, never put any fresh manure in contact with the roots of newly-planted trees, as this means simply death, especially to evergreens, but if the soil requires stimulating plough a light furrow from the trees on either side or one side will answer, fill this with well rotted manure and plough back. This will have the desired effect in time, without endangering the life of your trees. Finally there should be two planting days on every farm each year—one day to plant maples, elms, etc., and the other day evergreens alone, that would be later on in the season. Should this be a practice on every place what a boon it would be to every one in time. Nor should any one be deterred by the thought of the time it takes trees to grow in; they grow faster than many think, and any way some one will get the benefit of another's labor, as we often have rested in the shade and refreshed ourselves with the fruits raised by the thoughtfulness and industry of others.

Residents in the partially cleared parts of our country who have plenty of bush still standing, and more stumps than they care for, naturally cannot understand the interest taken in tree planting, or why so much is said and written about the subject. But to this class in particular we give special warning, be careful of your trees. Map out what fields you are going to have, and be sure when fenced to leave a good border growing around each field. Leave here and there an occasional five acre bush lot for future use, which will prove invaluable in the course of twenty years. To farmers in old sections of the country we say, if you have not a young nursery on your place set about at once. Fence an acre or so of good well-drained land for the special purpose of growing trees, lay out a ten or twelve feet border on one side, then a roadway that will serve as a headland to turn your horse on when cultivating or ploughing amongst the trees; lay out the rows for trees four feet apart. Plant some young maples, elms, ash or any trees you can get handy. Making a start and seeing nice young trees evenly planted will create a taste and desire to go on further, and will develop a love for a pursuit which when once commenced, will prove to be a fascinating and a productive one. To plant successfully, see your trench is deep enough, but just deep enough to receive them easily, without bending, but not too deep, as deep planting is more fatal than shallow. Newly planted trees of any class should be about an inch deeper than they stood formerly, after firmly treading and levelling nicely. Amongst newly planted trees you cannot hoe or cultivate too often to keep weeds down and the soil loose and mellow.

Most of tree planting on a farm can be done in the fall, especially trees such as larch, hard maple, willows, poplars, elms and ash. Evergreens will do better to leave till May. Thousands of young plants of European birch, sycamore, alders, lindens, English oak, Norway spruce, Austrian and Scotch pine, are imported by nurserymen from Great Britain and France every year. These are then grown into large trees and sold for the planting of parks, avenues, cemeteries, and private places throughout the country.

For your nursery then procure a few hundred of each variety from your nearest nurseryman, which can be procured very cheaply, and what with young trees,

deciduous and evergreen, you can procure from the woods, you will be soon surprised at the stock you will have. A few years work, and constantly adding to it, will provide you with abundance of trees to plant about the farm. But I need not enlarge on this, but simply conclude by urging a start to be made. At our school-houses much might be done to interest and instruct children in the knowledge of trees; to learn them to distinguish one variety from another, and how to grow them by having a small plantation comprising one or more of our native trees, properly labelled with technical and common name attached. A little has been done in this direction by instituting Arbor Day. We trust the love for planting trees will increase, and any effort in this direction should receive every encouragement.

To enter more fully into details respecting the growing and cultivation of the different trees, I repeat again that it is fortunate for us that our principal trees, native I mean, are easily propagated either from seed, or can be procured at an exceedingly low price from nurserymen. But the intending planter who wishes to learn how to produce stocks indefinitely for himself; who desires to become acquainted with all the minutiae of gathering seed, sowing, and the subsequent care necessary to grow successfully his own trees, cannot fail to do so, we think, if the following methods are observed.

To commence with the maple, it is necessary that they become acquainted with the different varieties, which for simplicity we will divide into classes, *i. e.*, the hard and the soft. The scarlet or soft maple when grown alone does not make a very upright growth, growing, in fact, very irregularly, forming a many-branched bushy head, but when planted closely in rows or in groups the crowding together has the effect of producing a much straighter tree, and, consequently, better timber. For shade and ornament it is indispensable. It is one of the earliest to bloom in the spring and very beautiful it looks; its small crimson blossoms appear thickly studded all over its leafless branches. For rapid growth, fine smooth bark and straight trunk, combined with luxuriant foliage, the silver-leaved maple is unequalled either for shelter-belts or street planting.

Both varieties *ripen their seed in the early part of June*. This fact we wish to impress on the memory of the reader, as at this season when every thing is in full foliage, and when other planting operations have just been completed, and the mind may be engrossed with the cultivation of the young growing crops, the ripening seed on maples and elms may be forgotten till too late to gather from having fallen and been scattered.

Observing then the seed crop on the trees carefully, and when ripe enough, which will be indicated by the seed beginning to fall; gather at once, and sow in a well-prepared bed of rich garden soil in drills opened by a hoe to the depth of two to three inches. Make the rows about twenty inches apart. Sow the seed moderately thick, or about as plentiful as you would sow beans. Cover the seed evenly and tread the soil firmly on the seed. The seed will start to grow in a few days, after which keep the ground clear and free of weeds and well cultivated. The first summer they will grow eighteen inches to two feet in height. From the seed-bed they may be transplanted the following spring into nursery-rows. This is the second operation, and the future success will depend on the soil and the cultivation given. The maple thrives in a rich, sandy loam, rather dry than moist, so that if land is low and wet it should be thoroughly drained. In fact, whatever here may be said about cultivating any tree, and the writer's main object in this article is to instruct or point out the means and the most expeditious manner to propagate young trees rapidly, without regard to the manner of their disposal afterwards by the grower, we must insist on

planting on dry soil, if not so naturally, to be made so by artificial drainage. To make a sweeping assertion, we maintain that no tree thrives in wet places, that any that may be found growing in wet situations would have thriven better if planted in well-drained soils in the corresponding time. Land well drained permits being ploughed and planted much earlier, is warmer in temperature, thus prolonging the growing season, while every one knows that the best time of the season for growth is in the earlier part, and this important advice applies to any operations on the farm, nursery or garden : *plant early*.

In preparing the young seedlings for planting, be careful to assort them all into even sizes ; this for convenience may be said to be three. namely, the large, the medium, and the small. By this you have all started evenly, which is really more important than may at first appear, for if the seedlings are planted without any regard being paid to size, the consequence is that the Darwinian truism "survival of the fittest," is exemplified with a vengeance. The largest having more root power rapidly possess themselves of all the "good things," to the almost complete extinction of their smaller brethren.

When sorting the seedlings have the pruning knife in hand, ready to trim any side-growth that may be on the plants, also to clip the roots into proper lengths, say six to seven inches. We say proper lengths, as anything over this is not actually necessary for the future welfare of the seedling, and the cutting of any long or tap roots has the effect of producing fibrous roots from the cut part, thus causing the young plant to thrive better besides. And this is important, minimising the risk of failure in future transplantings. Do not cut back any of the leading stem unless the plant has grown crooked by some means. In such a case it should be cut off just at the bend. Do not plant if your soil is very wet, it should just crumble, as if it is too moist it is apt to bake and crack, much to the injury of the young plantation.

Having the rows four feet apart permits the use of ploughing and cultivating with a horse, in fact, with an occasional hoeing by hand, the whole labour of cultivation can be suitably done by horse-power. Plant the seedling in the rows about a foot apart at first. After growing for two years they can be thinned out, leaving young trees four feet apart each way, when they may be left for permanent shelter and so on. All the foregoing instructions respecting planting and sowing the seed applies equally to the care of any trees that may be desired to grow. A crooked tree is an abomination, and sometimes, from one cause or another many of them exist in the rows. Wherever they are cut them down to the ground in the spring. The stock then will throw up numerous suckers. As soon as they appear, trim all off excepting the one appearing to be the straightest. This at once grows rapidly, having all the root-power belonging to the previous growth, and producing a smoother and straighter tree in less time than if allowed to grow without cutting.

The hard or sugar maple, a tree no Canadian can praise too much, or grow too many of, ripens its seed in the *fall*. Sow it at once, as directed for the soft maple ; but as the seed has to lie all the winter, it is necessary to have the seed-bed in such a location, or made so by surface drains, that no water can lie on it during the winter season, and another essential is to be sure and mulch the bed or seed-rows with a good top dressing of long manure or other litter. Manure is the best for the double reason of enriching the soil and preventing upheaval of the seeds by frost. In the spring, after the warm rains and settled weather has set in, remove the manure by raking to the centre of the rows, where it may be left, and where it will have the good effect of keeping the soil moist and preventing weeds from growing. The young seedlings will soon appear, and all the care they will require through the summer is an occasional hoeing. They

should make enough growth that season to warrant transplanting the following spring, if possible. They may be left, however, another year in the seed bed, when it will be imperative to move them. Whatever time you may transplant, give such attention to the manner of assorting and trimming as we recommended for the soft maple. They may be planted in the fall if the ground where they are to be planted is well-drained. Generally on the farm, there is more leisure in the fall to do work of this kind than in the spring, and the suitable time is any time after the first of October. If the leaves have not fallen strip them off by hand. This is necessary, for if the growth is not completed the evaporation of the sap by the leaf dries up the bark of the seedling and considerably weakens it if it does not actually destroy it altogether. It seems almost needless to point out the value of the hard maple. It is a tree both valuable for shade and for its sap to make into sugar, for which purpose alone it pays to grow in groves or in rows. Its wood is valuable for fuel and for lumber. The timber is used for flooring, and many uses too numerous to mention. Its foliage is clean and thrifty, and singularly free from insects of any kind. It is truly, in every sense, worthy of being the emblematical tree of Canada.

The Norway maple also forms an exceedingly handsome tree, (being superior for lawn or park purposes) to the sugar maple, having larger leaves and forming a dense round-headed tree of noble proportions, requiring only to be seen to be admired, and planted to be appreciated. It also ripens its seed in the fall, and requires the same attention advised for growing the other maples. When young it is a little tardy in growth, but soon afterwards makes a rapid and luxuriant growth.

There are many other sub-varieties of maples all of value, but known and grown for ornamental purposes principally. We have spoken hitherto only about growing the young trees from seeds, but in many places thousands of young trees in all sizes of growth, can be procured easily self-grown in the woods. Where such woods exist, having young seedlings growing in their midst, we advise procuring them in the fall, if possible. As at that time, there being no frost in the ground, and of a certainty much drier under foot, they can be collected with a greater degree of comfort, at any rate. Young plants of the elm, ash, birch and others, may be procured at the same time, assorting them afterwards into separate bundles for the sake of system and uniformity. In fact, so numerous are the self-sown plantations throughout the country, that hardly any one has any reasonable excuse for not having trees wherewith to plant. Where these seedlings can be procured, care should be observed to keep them covered from the sun by piling in a shady spot and covering with moss or other protection. Assort into sizes and trim roots and side branches, and plant in rows as before directed. Where it is not convenient to plant in fall, the young trees may be heeled in trenches in some dry spot, or may be kept in cellars, simply covering the roots with sand or soil. Remove any rubbish or weedy borders or other places of cover that would harbor mice, for this little animal plays great havoc by girdling the bark in the winter, particularly during heavy snow-falls. All plantations should therefore, have clean cultivation the first few years, as much to guard against these depredations, as well as to stimulate the growth of the young trees. After that time they furnish sufficient shade themselves to retard any undergrowth of weeds.

It may happen sometimes that opportunity offers to make plantations of young trees without the land being sufficiently rich to give a good after-growth to the trees. In such instances plough a furrow from the young trees on one side. This furrow fill up with good stable manure. A furrow thrown back again the opposite way will cover the manure, and furnishes in time all the

needed fertilization the young trees will require. But where it is possible, the deeper and better the land is cultivated the better the result. The question of distance is always a vexed one in regard to forestry, and taking the maple tree as an instance for all others, we say you have just the results that you may expect by considering the matter a little. The closer the trees may be planted, the weaker they will be; the farther apart, the stronger. As there is just so much nourishment for the roots in the soil, just so much moisture and just so many rays of sunshine, and nothing can add to or take from the whole sum; so that if twenty trees are planted where four should grow, you have the result of the growth of four trees divided into twenty. Or supposing an acre is planted with trees four feet apart each way, you would have 2,700. If planted eight feet apart, then you have 1,350. Those planted eight feet apart would give, at the same time, just as much return, if not more, than those planted four feet apart. I am inclined to think that six feet each way would be a safe distance, presuming the object is to grow trees for profit, etc. I omitted mentioning to give a summer pruning any time during July or August, not to touch leading shoots at all, but to trim off all side-shoots up to a height of say, six feet or higher, according to the sturdiness of the growth. Summer pruning may be omitted altogether where the trees show any indication to be weak or spindly; in such a case it's better to leave all lateral growth, as this will tend to thicken the growth or the diameter of the main trunk, the after-growth of the main head will shade so much as to completely stop all lateral growth, and any remaining will eventually die and drop off naturally, similarly to what has occurred in the primeval forest.

All varieties of the elm ripen their seed in June, when it must be gathered and sown in beds and treated in the same way as recommended for the maple. The Scotch or Wych elm is more prolific in bearing seed than our native species, while its wood is just as valuable if not more so. It starts into leaf earlier, and retains its foliage longer and thrives in all conditions of soil with equal facility. The bark of this variety is smoother, and the buds rounder, than our native elm, and taken all in all, it is an exceedingly desirable forest tree. We do not wish, however, to detract anything from the estimation of our native elm, which we regard with the greatest admiration. It may be properly called the palm tree of Canada. Towering up to a noble height, its branches dividing from the single shaft and spreading out into graceful proportions, covered with abundant foliage, presents, as a single specimen, one of the most beautiful objects to be seen in a Canadian landscape. For street planting I consider it to be the finest of all; growing rapidly to a height of forty to fifty feet, it permits a view of the houses and premises from the street, allowing the air to circulate freely, while its luxuriant foliage overhead gives grateful shade below. It bears transplanting with impunity as it rarely forms a tap root, and it can be moved as a large tree better than any other species. Its wood is used for many purposes, notably in carriage work, furniture or objects requiring bent or turned wood.

The other varieties, such as the corky elm and the red elm, differ but little in usefulness, excepting that they do not grow so large as the white elm. In nursery rows the elm soon makes a straight tree, but where there are two or more leaders it is advisable to tie them firmly together with hempen cord, so as to have one straight leader, and cut the others back to within six inches of the tied part. The spurs may be pruned close off as soon as the straightened part is firm enough to stand alone. This should be done with any of the other classes of trees that show two or more leaders. And to avoid repetition, the care necessary to produce one straight tree or grow it, for that matter, applies equally to all.

Coming to the *ash* family we find for general purposes this to be most useful

tree of all. The young trees are valuable almost from an inch in diameter, and an enquiry made by the writer from one of the largest implement manufactories in the Dominion of forks, hoes and other farming implements elicited the reply that the principal wood used in their establishment was the white and black ash, and they were now finding great difficulty in getting sufficient supplies to carry on business with. When one establishment out of the many engaged is put to straits at the present time what must the dearth be, say twenty-five years from now, if some prompt means are not taken to replenish the present stock by replanting. The ash tree, of which there are many varieties, the most useful being the white ash, grows very rapidly and freely in all soils, particularly in moist and humid situations. Though starting later in growth than any other of the different trees with the exception of the locust, it is yet quite desirable as an ornamental tree, while its value as a timber tree cannot be overestimated. It ripens its seed in the fall when it should be at once sown in rows and mulched as before advised. Its after cultivation is the same as other trees and the writer recommends it for planting for profit alone by the acre. Mr. Budd of Iowa, states "that ten acres of ash trees grown six feet apart, contained twelve thousand trees and at twelve years of age were eight inches in diameter and thirty-five high. The wood from thinning paid all expenses of planting and cultivation. The bodies of the trees cut out sold for forty cents each, and the tops were ten cents more. Ten acres of the timber twelve years old were worth six thousand dollars." This seems to be a very practical statement, and from the growing scarcity of this wood it would follow that here is a profitable speculation for any of our planters to enter into.

Our two most common varieties of the oak family are the white and red, which it is needless to state the former is the most valuable, and for durability, strength, and the many purposes it is applied to is the most valued of our native woods. It is second only to the hickory, but from the scarcity of this tree it cannot be said to compete. The better quality of white oak timber is said to be worth \$100 the thousand feet and scarce at that. How necessary then that steps should be taken at once to propagate this valuable tree, as it grows well on all soils but freely on good soil, and sufficiently to warrant growing it for profit in an ordinary lifetime. The acorns ripen in October when they should be gathered and sown at once, and as this is one of the first of the nut trees to be mentioned the directions here given will apply to all that class. The hickory, chestnut, walnut and beech will grow under the conditions advised for growing the oak. Gather the acorns or nuts as fresh as you can, sow in drills making two to three inches in depth—the larger the nut the deeper the drill,—cover with soil, tread firmly and mulch heavily. This is the great requisite, as most of the nuts will grow on top of the soil if only mulched with leaves or manure. If not possible to plant in the fall then put into boxes and mix with damp sand and leave outside in a shady spot where they will not be disturbed till the following spring when they should be planted as early as possible. From the seed bed transplant after one year's growth trimming off the tap root a little, say one-third of its length. There is no difficulty at all in transplanting the oak, chestnut, walnut, butternut or beech if they are planted promptly and not exposed too long to sun or wind. The hickory is the most diffident of all the nut trees, growing very slowly and forming a long tap root. In transplanting the hickory leave all roots on it, simply bending it in the trench and tramping the soil very firmly about the collar. This for transplanting. It is recommended, however, to plant the nuts where they are to grow into permanent trees and giving a course of cultivation, with most thorough and frequent stirring of the soil, keeping free from weeds, etc. To make it bear nuts early dig under with a sharp spade and cut the tap root, firming the soil back with a heavy tread of the foot. This has the same

effect as transplanting, only better, as it does not disturb any of the few fibres that may be growing laterally in the soil. The walnut and butternut both bear having the tap root cut back and transplanting quite readily, and the oftener they are transplanted when young the more easily they may be transplanted when they become large nursery trees; growing the nuts in sandy soil of any of the nut class of trees will induce more fibres than if they are sown in clay land, which they should never be at first. The sweet chestnut, which is rather a shy tree in transplanting, is easily grown from seed. Keep the nuts, after getting them as fresh as possible, in boxes well mixed with damp sand in the cellar in a cool temperature, so that they do not rot or mould. Sow the nuts in rows in spring say four inches apart and cover with a half an inch of soil. Cover the young growth the succeeding fall with coarse litter or loose straw six inches deep, transplanting the following spring. To return to the oaks, no one need be deterred from growing them for fear of not succeeding. They transplant quite easily up to a height of from three to four feet, but after that the percentage of loss would be too great to bother with them.

Our native basswood is a handsome, rapid-growing tree. The wood is of great utility from its toughness and lightness, and enters largely into modern manufacture. The seed ripens in the fall, when it should be gathered and sown. The European variety, or linden as it is commonly called, is grown by our nurserymen for ornamental purposes, and planted largely by apiarists as its flowers are said to yield a very superior honey. It is imported from European nurseries, where it is grown very largely. An avenue of this tree is planted in Berlin, Germany, which has become quite historic, and is often referred to in the doings of great personages as "Unter der Linden." This variety has not as large leaves as our native tree, and is very subject to attacks of the borer, which very much curtails its longevity.

One of the most useful trees, as well as being a very rapid grower and coming soon into the market for many uses, is the European larch. This variety is quite superior to our native tamarack, growing more erect. It is imported at such a small cost from the old country that it would not pay any one here to grow it from seed, unless they made a specialty of it along with evergreens which require the same treatment. The larch occupies a middle place between the deciduous and evergreen classes of trees. It belongs to the coniferae, from having cones, the wood being resinous, the arrangement of its leaves and branches the same as the spruces, but it resembles the deciduous because it drops its leaves. In this it resembles the deciduous cypress. It is the earliest tree to commence growing in the spring and therefore should be planted in the fall or the very first thing in spring. A row of trees which the writer helped to plant in 1873 are now from thirty to forty feet high and varying from eight inches to a foot in diameter one foot from the ground. They could now be cut down for fence posts, shed rafters or scaffolding poles, or firewood. The trees are as straight literally as gun barrels and present a very fine appearance.

Both our native basswood and European linden furnish that useful material, indispensable with nurserymen and gardeners, termed bass matting, and its production is as follows: Early in summer, say about the first of June, sections of the bark of matured trees from one foot to three in diameter are removed in widths of a foot wide and six feet in length or thereabouts; these are laid in a shallow pit and covered with water; there they remain from two to three weeks; when the inner bark will be found to come off in sheets of a thin papery-like substance, but of sufficient strength to be used for tying up all kinds of buds and plants, or any work common in greenhouses and nurseries. In the old country it is woven into mats, useful for shading and protecting hot-beds, or for packing purposes in hardware and crockery business.

Speaking of soft wooded trees, such as willows and poplars, we wish to draw attention to their great value for retaining banks by taking cuttings of stout one and two year old woods, a foot in length, and pushing into the bank or by making notches with a spade and inserting the cuttings to the topmost bud, making sure to firm the soil well around them. They soon grow and serve the purpose of nurses to other trees, such as maple, birch or evergreens of the different kinds, as pine, cedar and spruce. After these are well established, the willows or poplars may be cut down repeatedly till such times as the harder wooded and more valuable trees occupy the ground. The planting of the side hills and deep bluffs, now naked and bare, would conduce greatly to keeping up a supply of fresh water during the season in the flats and creek beds now so universally dry and bare during the hot weather. We know of thousands of acres of side hills that are entirely unfit for cultivation, that could be made to serve the necessary purposes for providing shade and shelter, wood and water, by replanting in the way we have pointed out. The retention of the winter's snow by the shade of the pine and cedar, would prolong the supply of fresh, cool water, a desideratum on stock farms too valuable to be estimated. We well know now that springs and watercourses familiar to us in boyhood, have long since dried up, not altogether due to the deforesting of the tree clad hills and valleys, but also to the universal practice of underdraining. We well know that where drains, surface and under, are in good working order, the surplus moisture in the land is soon run off on the hill sides or into natural hollows, which in the spring run off the water, flooding the creeks and lower lying lands. But I do not say a word against underdraining; that would be an outrage on all accepted canons of agriculture that I do not dream of committing, but I do say leave the trees and all possible undergrowth to protect the banks and hill sides, so that where drains, under or over, discharge their contents, it can be used to irrigate the banks and covers, furnishing the needed moisture to stimulate the growth of what may be now growing, and to start the dormant tree seeds that lie plentifully enough beneath. By doing this the arable uplands and plateaus are kept well-drained, but fringed around with a crown of sheltering trees, that break the biting winds from every quarter, retaining the snow—nature's protector in this land of sunshine—as well as keeping the land well drained. So that each operation will work to the other's advantage. This is the only happy medium in Canada.

With many, the great objection to forest tree planting is, that it takes so long a time to grow trees, forgetting that every season they thus delay they are prolonging this time indefinitely. Inside of twenty years the writer has seen piles of cordwood, nearly as long as the rows of trees they were cut out of, cut from trees he had helped to plant as cuttings and young plants from seed bed. While long before that the same rows furnished trees thinned from them that are now growing on streets and in parks, an ornament to their surroundings and a lasting credit to their planter.

In evergreens we are particularly rich in Canada. The species indigenous to our soil, comprises the most valuable woods in the world. From the great demand, however, and the reckless destruction that follows in the wake of the lumberman, the most prompt steps should be taken at once to conserve what we may have left, as well as to renew by replanting. Towards this object then, every energy should be directed before we kill the bird altogether that lays the golden eggs. All varieties are easily grown from seeds sown in a shady, moist location, but where the young plants have free access to air. A suitable bed is made by having cold frames, that is boards six inches deep, five feet wide, and any lengths to suit the quantity of seed desired to be sown. Make the bed of

sandy loam, and sow thinly in drills six inches apart and half-an-inch deep, covering slightly and pressing the soil firmly with the rake head, shade the bed with lath frames nailed diagonally with diamond-shaped interstices, this gives that shifting shade and light the plant would if receive grown in a natural way in its natural forest. When young seedlings appear, lift the outside frames sufficiently high to permit a brick or other object being set underneath to keep it there. This has the effect of allowing the air to circulate freely amongst the young plants, hardening them and drying the surface of the soil, thus preventing what is termed damping off. Seeds may be procured from the cones, which should be gathered in the fall and hung up in muslin bags in a warm place, the temperature reflexing the scales of the cones, allowing the good seed to fall out into the muslin. Keeping them this way prevents mice from eating the seeds, besides preserving the seeds from mould and mildew.

When is the proper time to plant evergreens is a question frequently asked. When a person is careful to keep roots damp and covered up from the sun and wind an evergreen may be planted at any time of the year. The writer has helped to plant hedges in August which have grown with scarcely requiring a plant to be renewed, simply because they were not exposed, and were freely watered after being planted, but to definitely state a time to suit all varieties and locations we say any time during the month of May. At this time when the roots are beginning to show the young white tips of the new growth and top buds are also showing signs of starting we have always found to be the most fortunate time. When setting out young trees from woods or nurseries, be sure to make a what is termed a grout or in other words a thin mud of clay into which dip the roots, this forms a moist adhesive covering which prevents undue exposure of the roots till such time as they come in contact with the soil in new plantations. In planting be careful not to plant too deep; more trees die from deep planting than by being too shallow. Allowing for the subsidence of the soil after planting, a tree should then stand the same depth in the soil as its roots were covered in its former nursery or forest home. Firmly tramping the soil is the most necessary act in successful planting, and also to be careful not to allow any fresh manure to come in contact with the roots. It would be fatal kindness to allow that, but if the soil requires enriching rather put it as a mulch on top of the soil. Evergreens are impatient of manure anyway, and thrive on thin sandy soil better than any other class, so long as it is naturally dry or made so by artificial drainage. In making young plantations or setting out plants for the purposes of growing, to draw from as occasion may require in planting shelter belts, put them as closely together in rows and have the rows as close also as will permit cultivation. By so doing, the plants give mutual protection, shading the ground, keeping the roots cool and moist, and creating that still atmosphere amongst its branches so conducive to the health of evergreens; never plant evergreens among deciduous trees but always in groups or rows by themselves; the drip from the foliage of large leaved trees and their overshadowing influence is particularly fatal to evergreens.

HOW TO PROCURE GOOD FOREST TREES FOR PLANTING.

The following article is by the Hon. H. G. Joly, Quebec, and was read by him at the late forestry meeting there. It contains, in short space, much useful knowledge, and may be thoroughly depended on:—

It is not easy to procure young forest trees worth planting. The trees raised in the *nurseries* can generally be relied upon, and they are sold at

moderate prices, but owing to distance, want of easy communication, delays in forwarding and delivering, (which are often the cause that the trees, when received, are unfit for planting) and to the cost, however moderate, it is very seldom that the farmers have recourse to the nurseryman for the *forest trees* they intend planting. (I do not allude, here, to *fruit trees*).

They generally go to the woods for them, often a distance of several miles. Those who have tried it know how hard it is to find such trees as they want, how much time and trouble it takes to dig them up, and how impossible it is, even with the greatest care, to avoid wounding and tearing off the roots. They know, too, how little satisfaction they have generally derived from all that work. Trees taken out of the forest and transplanted on the open, are placed at a great disadvantage; they fail so often that people get discouraged, and many give up tree planting as too difficult an undertaking.

Nothing is easier; in the proper season, with soil fit to grow the kind of tree you wish to plant, if the tree is *in good order*, with a little care you ought to succeed. But the trees you dig out of the woods are seldom in *good order*, and they cost you a high price in time, if not in money. If you wish for good trees, in great number, safe to grow without trouble or expense, procure them from a nursery, *but let that nursery be your own*.

Any farmer can start, in the corner of his garden, a nursery of forest trees, by sowing the seeds of the trees he wishes to plant. With a little observation, it is easy to find out when the seed is ripe. For instance: towards the end of June, beginning of July, the seed of the *elm* and of the *soft maple* (*acer rubrum*) is ripe; by sowing it at once it will sprout, and the little trees grow nearly one foot in height this summer.

The maple, oak, ash, birch, butternut, etc., ripen their seed in autumn. Better sow it at once than winter it in the house. Sow in straight rows, with a garden line, leaving a picket at each end to guide you when weeding. Sow, say half-an-inch deep for the maple seed, and for other kinds, in proportion to the size of the seed, two or three inches deep for butternut and walnut. Thin after the first year, if needed, and transplant further on the little trees removed in thinning. After three or four years, more or less, (the time will depend on the rate of growth of each kind of tree) plant your young trees where they are destined to stay. Choose a cloudy or rainy day in the spring, and, without leaving home, with no trouble, without breaking any roots, you will take up and plant at once, without allowing the roots time to dry, one hundred young trees, certain to grow, in less time than it would take you to go to the woods and dig up ten trees, with a poor chance of their taking root and living.

These young trees will cost you nothing; your children will soon learn how to weed them and take care of them, especially if you set them the example. Our own children, when quite young, took pleasure in sowing acorns and watching the growth of the young oaks as they came up. By sowing you can procure, with no expense, any number of young trees, and re-wood, by degrees, all the land which is not fit for cultivation and ought to have been kept as wood land.

But do not forget to *fence* carefully your nursery and your plantations, so as to keep out the cattle. No use planting trees without fences; the cattle will destroy everything.

In many cases nature will spare you the trouble of sowing. Where the ground is favourable, in July and August, along the ditches, the roads, the fences, on the moss on barren patches, wherever there is a little dampness, in the neighborhood of the *elms* and *soft maples*, you will find hundreds of young elms

and maples just sprung up from the seed fallen from those trees; plant them in your nursery, *try it this summer*; the seed of the elm is so minute and delicate, that it is better to pick up those young seedlings than to attempt sowing the seed.

In the maple groves the ground is covered with a regular carpet of young maple seedlings. You can pull them up easily by hand in the fall or early spring, when the ground is still damp, without breaking any of the small roots. Plant them at once in your nursery.

It is very difficult to collect pine and spruce seed. Early in the spring, when the ground is still soft and spongy in the pastures, near where those trees grow, you will see a number of young pines and spruces that you can pull up very easily; plant them at once, for that kind of tree you must shelter from the sun until they are well rooted.

Whenever the ground of a garden has been dug up and worked in the fall, if there are any maple or ash growing in the neighborhood, it will be noticed that the ground in the spring is more or less covered with maple and ash seedlings, grown from the seeds fallen from those trees. It takes a very little time to pull up and replant hundreds of them, and scarcely any of them will fail; of course they must not be pulled up too roughly or it may damage the delicate roots; if the ground is too hard use a trowel. As much as practicable, they ought to be pulled up when they have only got their two first leaves, which are easily known by their peculiar shape, long and narrow, from one inch and a half to two inches long, and about a quarter of an inch wide.

For several years past I have been seeking the cheapest and, at the same time, most effective mode of restoring the woods, where they have been completely destroyed. Many of our old settlements are completely denuded of trees, and I can recommend the simple mode as the best, from my personal experience. Let those who suffer for the want of fuel, of timber for building, of trees for shelter and ornament, and those who would look to have a sugar maple grove at their door, let them start their own nurseries this very summer; it will entail no expenditure of money, take but very little time, and repay them bountifully. It will be a pleasure for me to give any further information, and advice to all those who may apply for it.

H. G. JOLY DE LOTBINIERE.

LECLERCVILLE, P. Q., May 1, 1890.

INFLUENCE OF WIND-BREAKS ON FRUIT PLANTATIONS.

This question, of very great importance to the farmers of Ontario, is not viewed by all alike. The best writers recommend wind-breaks for fruit plantations, but fruit growers are not so unanimous. I have endeavoured to obtain the opinion of Canadian farmers on this subject, but the replies were not sufficiently numerous for the purpose. It happens, however, that the College of Agriculture of the Cornell University, has instituted a wide-spread enquiry into the matter, and have obtained a large number, that is to say, forty-eight replies stating definite results. They chose New York and Michigan for their enquiries. As it is impossible to condense their information closely, I have copied their tables of answers, both as to effects observed from, and the proper methods of planting wind-breaks:—

I.—EXPERIENCES FAVORABLE TO WINDBREAKS.

A. IN NEW YORK.

OBSERVER.	Site and Soil.	Direction of Prevailing or severest winds.	Location in reference to large bodies of water.	Kinds of fruit grown.	Kind of Windbreak.	BENEFITS DERIVED.
Patrick Barry, <i>Rochester.</i>	Various.	W.N.	About 6 m. South Lake Ontario.	All kinds.	Norway spruce, European larch, and other evergreens.	"We regard windbreaks, in this country, as of vast importance, not only in fruit cul- ture, but for the comfort of man and beast." Increased crop. Less loss from wind-falls. No loss from severe cold.
Irving Rouse, <i>Rochester.</i>	Same level as surrounding land. Clay. High, sandy loam.	N.	do	Apples.	Norway spruce, on Northwest.	
J. Wentz, <i>Rochester.</i>	High, sandy loam.	W.	do	Plums.	Siberian arbor vitae.	Good.
T. G. Yeomans & Sons, <i>Walworth.</i>	Undulating, strong, sandy loam.	W.	About 8 m. South Lake Ontario.	Apples, Dwf. Pears. Quinces, small fruits.	Norway spruce, mixed belts, and natural forest.	Prevent windfalls. Render orchards more uniformly productive and longer lived. Render labor easier.
W. T. Mann, <i>Barkers.</i>	Slightly rolling, clay and sandy loams.	W.S.W. N.W.	2 m. South of Lake Ontario.	General.	Row of Norway spruce on W., set 2 ft. apart in 1874.	Fruits, especially pears and berries, have blossomed and, ripened several days earlier near windbreak. Fewer windfalls. Retains snow for 10 to 15 rods from windbreak.
B. W. Clark, <i>Lockport.</i>	.....	SW.	About 10 m. S. L. Ontario	General.	Norway spruce, natural forest.	Good.
G. W. Dunn, <i>Pierce's.</i>	Same elevation as surrounding orch'ds. Loam.	W.	On Lake Ontario.	Apples.	Beechwood land.	Trees start earlier. Fruits hang on longer. Winter apples more easily gathered.
C. P. Whitney, <i>Orleans.</i>	Very high ridge W. slope. "Limestone."	W.N.	N. of Canandaig- ua and Seneca L. —about 8 miles.	Apples set in '73 and '74.	Natural forest.	"I see no difference in the growth of trees, except that they stand straighter where they are protected."
V. B. Wheat, <i>Orleans.</i>	High, sandy loam, ranging to gravel.	W.N.	do	Grapes, Apples, Peaches.	Natural forest.	"I am very certain that the protection from forest is beneficial in various ways."
S. C. Davis, <i>Medina.</i>	High. Clay and gravelly loam.	W.N.	About 10 m. So. L. Ont.	General.	Norway spruce.	Good.
E. B. Norris, <i>Sodus.</i>	Mostly high. Sand, grav. loam	W.N.	On Lake Ontario.	Apples.	Norway spruce.	Good.
C. H. Perkins, <i>Newark.</i>	.....	W.	About 15 m. So. L. Ont.	Small fruits, grps, 'q'nes & peaches.	Norway spruce.	Protects from cold snaps; "no telling the good a windbreak will do."

W. G. Ellwanger, <i>Canandaigua.</i>	High.	W.	On Canandaigua Lake. Midway bet. Canandaigua and Seneca Ls. About 6 miles. At north end of Keuka L.	Orchard fruits & nursery stock.	.....	Fewer windfalls. Prevents ground from freezing too deep and destroying nursery stock. Fewer windfalls. Trees become more firmly rooted, and are more upright.
H. J. Peck, <i>Seneca Castle.</i>	E. and W. slope. Heavy loam.	W.		Apples set in 1873.	Closely planted apple orchard on west.	
G. C. Snow, <i>Penn Yarn.</i>	100 to 500 ft. elevation. Grav-elly loam.	W.		Peaches, apples, grapes.	Natural forest on W. and S. W.	Fewer windfalls. Less liability to damage to fruit buds from cold. Retains snow and leaves. "The result, I think, has been beneficial to the peach crop."
C. W. Pierson, <i>Waterloo.</i>	Slightly higher than adjacent lands. Sdy loam.	W.N.	Bet. Cayuga and Sen. L. —about 5 m.	Peaches and apples.	Norway spruce hedge, kept cut back to 10 or 12 ft.	
A. I. Hulett, <i>Elba.</i>	Gravelly loam.	W.S.W.	About 20 m. south Lake Ontario.	Apples and pears.	Natural forest.	
P. B. Grandall, <i>Ithaca.</i>	High.	W.	At south end of Cayuga Lake.	Peaches.	Farm buildings on north.	"Apples and pears so protected rarely fail, while others, on equally as good soil and exposed, fail one year out of three;" "Trees will blossom full this spring; in the field with no protection, buds have been mainly destroyed."
J. J. Thomas, <i>Union Springs.</i>	.....	W.	Near N.E. cor of Cayuga Lake.	Pears.	Double row of Norway spruce on west.	Trees near the windbreak less injured by cold winter winds.
Anthony Lamb, <i>Syracuse.</i>	Same level as adjacent lnds. Clay l'm	W.N.	Near Onondaga Lake.	Nursery stock, grass and grain.	Norway spruce.	Much less injury to nursery stock from cold.
E. A. Powell, <i>Syracuse.</i>	do	W.N.	do	Nursery stock, also gen'l crops.	Norway spruce.	Protects nursery stock from effects of cold.
G. T. Powell, <i>Ghent.</i>	100 feet above adjacent lands.	W.N.	About 8 m. east of Hudson River.	Apples, pears, grapes and cherries.	Elms, maples and Norway spruce.	"Saves a large amount of fruit from being blown off." Holds snow. Lessens evaporation from the soil. Encourages birds.
Charles Gibson, <i>South Haven.</i>	Gravelly loam. High. Sand.	W.S.W.	On east bank of Lake Michigan.	Peaches.	Lombardy poplars and natural forests.	Keeps fruit from blowing off, and prevents breaking of trees when loaded with fruit or ice.
R. Linderman, <i>South Haven.</i>	Very high. Sandy.	W.S.W.	On east shore of Lake Michigan.	Peaches.	Norway spruce on the west.	Protects from cold winds, especially in blossoming time. In a certain year a NW. wind in blossoming time, destroyed half or more of the crop on west of screen, but the protected orchard had a full crop.
H. J. Edjell, <i>South Haven.</i>	Very high. Sandy.	W.S.W.	On east shore of Lake Michigan.	General.	Norway spruce enclosure.	Temperature is 5° higher in protected places in very cold weather. The most productive grapes are next windbreak. "I am thoroughly convinced of the value of a windbreak."
L. H. Bailey, <i>South Haven.</i>	High. Sandy.	W.S.W.	On east shore of Lake Michigan.	Apples.	Apple orchard.	Windfalls are half less where trees are protected.

EXPERIENCES FAVORABLE TO WINDBREAKS.—Continued.

OBSERVER.	Site and Soil.	Directions of prevailing or severest winds.	Location in reference to large bodies of water.	Kinds of fruit grown.	Kind of Windbreak.	BENEFITS DERIVED.
J. F. Taylor, <i>Douglas.</i>	80 to 100 ft. ab. lake. Sandy.	W.S.W.	90 rods E. of L. Michigan.	Apples and peaches.	Nat. forest, Lomb poplars, Scotch pine.	Retains snow. Prevents the falling off of fruit.
G. C. McClatchie, <i>Ladington.</i>	High.	W.S.W.	On Lake Michigan.	Peaches and plums.	Natural forest.	Retains snow, and thus greatly protects trees.
S. M. Pearsall, <i>Grand Rapids.</i>	Same elevation as surrounding lands. Gravelly loam.	N.W.	About 25 miles east of Lake Michigan.	Apples.	Black walnut and butternut.	"The trees were not affected by the winds as much as my other orchards, and, I think, withstand the frosts better."
H. H. Hayes, <i>Talmadge.</i>	50 to 100 ft. higher than adjoining lands. Clay.	E.N.E.	About 20 miles east of Lake Michigan.	Apples, peaches and grapes.	Natural forest.	Protects trees from cold snaps.
J. N. Stearns, <i>Kalamazoo.</i>	Same level as adjoining lands. Gravelly loam.	W.	40 miles east of Lake Michigan.	Bush fruits and grapes.	Norway spruce hedges, 12 to 15 feet high.	Holds snow, the protected "plants coming out much more fresh than those exposed. In summer, prevents wind from drying up the fruit.
R. J. Coryell, <i>Jonesville.</i>	High, sandy loam S.W. exposure.	S.W.	Inland.	Apples and bush fruits.	Nat. forest and row of deciduous trees.	On side next the windbreak, more healthy trees and fairer fruit.
L. D. Watkins, <i>Manchester.</i>	60 ft. above adjoining lands. Gravelly loam.	W.N.	Inland.	Apples and peaches.	Second growth forest.	Protects from cold. "Peach crop has failed but once in eight years. All orchards failed in this vicinity except these and a few protected trees.
J. Austin Scott, <i>Ann Arbor.</i>	.....	N.W.	Inland.	Apples and pears.	Norway spruce and arbor vitæ hedges.	Good.
J. D. Baldwin, <i>Ann Arbor.</i>	Very high. Clay.	N.W.	Inland.	Apples, pears and peaches.	Second growth forest and Norway spruce.	Good for apples and pears.
D. G. Edmiston, <i>Adrian.</i>	Somewhat elevated. Strong clay loam.	S.W.	Inland.	Apples and pears.	Norway spruce.	Protected trees are healthier, and better shaped than others.
E. P. Allis, <i>Adrian.</i>	High. Heavy.	W.N. SW.	Inland.	Grapes, cherries, quinces, bush fruits.	Apple orchard.	"I think it is a great advantage."

BENEFITS EXPERIENCED.	Number of observers.	No. occupying high sites.	No. occupying comparatively low sites.	No. occupying light soils.	No. occupying clay or heavy loams.	No. evidently influenced by bodies of water.	No. evidently not influenced by bodies of water.
In general,.....	37	21	8	17	11	27	10
Protection from cold,.....	12	7	3	5	3	9	3
Lessening of windfalls,.....	11	6	4	6	4	10	1
Retention of snow,.....	6	4	2	4	2	4	2

2.—DEFINITE OBSERVATIONS WHICH FAVOR WINDBREAKS.

OBSERVER.	Site and Soil.	Direction of prevailing and severest winds.	Location in reference to large bodies of water.	Kinds of fruit observed.	Kind of windbreak observed.	BENEFITS OBSERVED.
O. J. Weeks, <i>West Webster.</i>	In general.	.....	Very near Lake Ontario.	Apples and pears.	Forests and artificial shelter beds.	Fewer windfalls; "some years, more than one-half the entire crop" blowing off in exposed orchards, while few blow off in those well protected.
D. Bogue, <i>Medina.</i>	Clay loam.	.....	About 10 miles S. of Lake Ontario.	Pears, apples, cherries and plums.	Norway spruce hedge.	Fewer windfalls.
W. C. Almy, <i>Dundee.</i>	In general.	N.W.	3 m. west of Seneca Lake.	In general.	Natural timber.	"Where the wind is very severe, a wind-break on the north and west would be very valuable"
A. Hammond, <i>Geneva.</i>	In general.	N.W.	N. end of Seneca Lake.	In general.	In general.	Fewer windfalls. High ground on the west is "quite important in many respects."
A. S. Dyckman, <i>S. Haven, Michigan.</i>	High. Sandy.	W.S.W.	On E. shore of L. Michigan.	Peaches.	Evergreen hedge.	Prevents the blowing off of snow and sand.
C. J. Monroe, <i>S. Haven, Michigan.</i>	In general.	W.S.W.	On E. shore of L. Michigan.	General.	Street trees.	"If all our highways were bordered with good rows of trees, we should find much advantage from them."

4.—EXPERIENCES ADVERSE TO WINDBREAKS.

OBSERVER.	Site and soil.	Direction of Prevailing and severest winds.	Location in reference to large bodies of water.	Kinds of fruit grown.	Kind of Windbreak.	INJURIES SUSTAINED.
H. M. Jaques, <i>Lockport.</i>	.....	SW.	About 10 miles So. L. Ont.	Apples and pears.	Natural forest on North.	"Apples next the woods are poor color and very wormy."
S. D. Redman, <i>Newfane.</i>	Level. Gravelly loam.	W.S.W.	Very near L. Ontario.	Quince.	Norway spruce hedge on E. W. and N.	"Have not been able to detect any difference in trees or fruit from those not so protected."
Julius Harris, <i>Ridgeway.</i>	Sandy loam.	W.	About 5 miles So. L. Ont.	Apples and Peaches.	Natural forest.	Next the windbreak, trees less thrifty and apples fall more and earlier.
Geo. Catchpole, <i>North Rose.</i>	Same level as adjoining land—Sandy and clay loam.	W.	About 5 miles So. L. Ont.	Apples and Peaches.	Natural forest on East, North and West.	"The more windbreaks, rail fences, brush and other matter, the more insects."
Oscar Weed, <i>North Rose.</i>	.....	W.	About 5 miles So. L. Ont.	Apples.	Natural forest on West.	"The trees along the woods for several rows were more infested with worms than the balance of the orchard and bore less fruit."
C. H. Hess, <i>Castile.</i>	Somewhat elevated. S. & E. exposure. Gravelly loam.	W.N.W.	Inland About 4 m. S. of Silver Lake.	Apples.	Natural forest on North & North-West.	"It has been very noticeable that the fruit grown on the part of the orchard toward the piece of woodland is always wormy, knotty and inferior, never suitable for barrelling."
N. J. Edmunds, <i>Brockport.</i>	High. Sandy loam.	W.	About 10 miles S. L. Ont.	Peaches and Apples.	Natural forest.	"The best results in both apples and peaches were where the trees were most exposed to the wind and sun, and the poorest within ten rods of the forest."
M. F. Varney, <i>North Collins.</i>	.....	SW.	About 8 miles East L. Erie.	Grapes.	Natural forest.	"Have noticed some times that grapes do the best where the wind is least broken."
W. G. Ellwanger, <i>Canandaigua.</i>	High.	W.S.W.	On Canandaigua Lake.	Peaches.	.....	"I find that for peaches it is the best to have no protection."

5.—DEFINITE OBSERVATIONS ADVERSE TO WINDBREAKS.

OBSERVER.	Site and Soil,	Direction of Prevailing and severest winds.	Location in reference to large bodies of water.	Kinds of fruit observed.	Kind of windbreaks observed.	INJURIES OBSERVED.
W. Hopkins, <i>Leviston.</i>	In general.	W.SW.	On Niagara R. about 8 miles So. L. Ontario.	Apples and Peaches.	In general.	Fruit more wormy.
J. A. Root, <i>Skaneateles.</i>	In general.	.....	On N. end of Skaneateles L.	In general.	In general.	"Late spring frosts do far more damage to grapes, peaches, etc., in a protected location than where the wind has free play." "More frosty."
A. S. Dyckman, <i>So. Haven, Mich.</i>	High. Sandy.	W.SW.	On east shore of L. Michigan.	Peaches.	Natural forest.	"W. N. Cook, Chas. W. Garfield, S. M. Pearsall, and John Pailow, were all agreed that windbreaks are not desirable, as a cold wave is likely to settle down on trees when immediately under the shelter, which those farthest away have escaped.
Members of Grand R. Valley Hort. Society, <i>Grand Rapids, Mich.</i>	High. Gravelly.	W.	About 25 miles East of Lake Michigan.	Peaches.	In general.	"In the summer following the cold winter of 1872-3, I travelled over a large part of Kent and adjoining counties, and closely observed the influence of windbreaks. Wherever peach trees were situated on the east side of such timber belts, they were all killed, and the Baldwin apple fared little better; while on exposed places of the same elevation, the trees were alive and often bearing fruit. I saw several peach orchards with protecting thickets on the east, and they were uninjured." Trees killed by cold winters next the windbreak.
W. N. Cook, <i>Grand Rapids, Mich.</i>	In general.	W.	About 25 miles East of Lake Michigan.	Peaches.	In general.	"Have known orchards protected by woods on N.W. and W. to do well, and have known them to do equally well without protection. Do not believe that a single windbreak is of any advantage."
J. A. Pearce, <i>Grand Rapids, Mich.</i>	High.	SW.	Ab. 25 m. E. of L. Michigan ¹ . Inland.	Peaches.	.....
J. F. Fitzsimmons, <i>Hillsdale, Mich.</i>	.....	SW.W. NW.		.....	Natural forest.	

II.—PROPER LOCATION AND MANNER OF MAKING WINDBREAKS

I.—*The Location.*

The answer to this printed question must vary greatly with circumstances and with the kind of fruit. Some localities are greatly exposed to prevailing winds; others are screened by hills or sheltered in depressions, and do not need screens. But our hardiest fruits are better off with some protection.—*J. J. Thomas, Union Springs.*

Where we have occupied grounds with a western exposure, we have usually planted lines of Norway spruce on the western border. * * * How to avoid the severity of the west winds has been a constant study with us.—*Patrick Barry, Rochester.*

Wherever the orchards or small fruit plantations would otherwise be exposed to strong winds.—*W. T. Mann, Barker's.*

Where the wind has a sweep of a mile or more.—*B. W. Clark, Lockport.*

Under all circumstances with which we are acquainted, peach trees should not be planted nearer than five rods from a dense windbreak, or the drifting snow will break them down. Apple trees may be planted some nearer.—*Geo. W. Dunn, Pierce's.*

Should plant windbreaks for all fruits except apples. No telling the good a windbreak will do.—*C. H. Perkins, Newark.*

Where there is a long exposure to west and south-west winds.—*A. I. Hulett, Rochester.*

Under all circumstances where ground is exposed to severe winds.—*Irving Rouse, Rochester.*

In all bleak locations; also to a moderate extent as ornaments and for general protection.—*S. C. Davis, Medina.*

Where an orchard has a northern and western exposure.—*E. B. Norris, Sodus.*

1st. Where it is impossible to get a good exposure; 2d, where fruit is planted which is especially liable to loss from wind, as King apples or Duchess pears.—*H. J. Peck, Seneca Castle.*

Upon a site that is exposed to a cold and bleak north or west wind.—*C. W. Pierson, Waterloo.*

Where orchards and fruit plantations are so situated as to be exposed to cold bleak winds; in fact, in all exposed places I have no doubt windbreaks are very beneficial.—*Anthony Lamb, Syracuse.*

On all elevated, exposed locations, in order to hold the snow more evenly over the land and to prevent the evaporation that takes place rapidly with a high wind. Also to furnish nesting places for birds.—*Geo. T. Powell, Ghent.*

In all windy places.—*D. Bogue, Medina.*

Where the wind is very severe, a windbreak on the north and west would be very beneficial.—*Wm. C. Almy, Dundee.*

In exposed places where sandy ridges are liable to blow away.—*A. S. Dyckman, South Haven, Michigan.*

I would set nut-bearing trees on the north and west of all fruit orchards, for protection and for the nuts.—*S. M. Pearsall, Grand Rapids, Michigan.*

Where the snow blows off.—*Geo. C. McClatchie, Ludington, Michigan.*

I would recommend them wherever land is exposed to raking winds, first for retaining snows on the ground; second, to protect fruit from winds.—*J. F. Taylor, Douglas, Michigan.*

In my situation I should want the windbreak some forty to eighty rods from the orchard on the west, and extend to the north. Do not think it would

be safe to plant one close upon the west side of my orchard, for fear of still air settling down over the break.—*H. H. Hayes, Talmadge, Michigan.*

For all small fruits especially, for all soils and localities.—*J. N. Stearns, Kalamazoo, Michigan.*

Where the land slopes to the prevailing wind. Should want it only high and thick enough to break the force of the wind, not to produce a dead calm.

—*R. J. Coryell, Jonesville, Michigan.*

In all exposed situations.—*L. D. Watkins, Manchester, Michigan.*

Would plant my hedge on the side where most exposed to high winds.—*J. Austin Scott, Ann Arbor, Michigan.*

Wherever the grounds are exposed to the south and west winds.—*D. G. Edmiston, Adrian, Michigan.*

2.—CHARACTER OF A GOOD WINDBREAK.

We have usually planted lines of Norway spruce on the western border. Sometimes a line of European larch is planted with the spruce. These and the Scotch and Austrian and white pine are all good for windbreaks.—*Patrick Barry, Rochester.*

Evergreens are certainly preferable to deciduous trees. Judging from observation, Norway spruce in single row planted two feet apart is best.—*W. F. Mann, Barker's.*

We should recommend the Norway spruce planted in a single row from six to eight feet apart, or set four feet and every other one removed in a few years. If the location is much exposed, we would recommend a row or two of maples on the windward, set from eight to ten feet apart in the row, the rows being from ten to fourteen feet apart.—*T. G. Yeomans & Sons, Walworth.*

The best kind I ever used or saw, was a good Norway spruce hedge set close enough together to make a tight break, and trimmed back until they had formed a tight hedge, at least ten feet high.—*E. B. Norris, Sodus.*

I do not believe that a solid windbreak would be desirable, as a circulation of air is necessary. We need only to break the power and force of the wind.—*Geo. T. Powell, Ghent.*

Evergreens.—Norway spruce, Austrian pine, Scotch pine, etc., planted in wide belts and not too close, but irregularly, something like nature.—*A. Hammond, Geneva.*

Something tall but not too thick, that will allow a free passage of wind, but moderate its force. I have some faith in Lombardy poplar trees for this purpose.—*A. S. Dyckman, South Haven, Michigan.*

Norway spruce every time, set four feet apart. Keep well sheared and you can have a perfect hedge as high as twenty or even thirty feet.—*J. Austin Scott, Ann Arbor, Michigan.*

GENERAL SUMMARY.

1. A windbreak may exert great influence upon a fruit plantation.

2. The benefits derived from windbreaks are the following: protection from cold; lessening of evaporation from soil and plants; lessening of windfalls; lessening of liability to mechanical injury of trees; retention of snow and leaves; facilitating of labor; protection of blossoms from severe winds; enabling trees to grow more erect; lessening of injury from the drying up of small fruits; retention of sand in certain localities; hastening of maturity of fruits in some cases; encouragement of birds; ornamentation.

3. The injuries sustained from windbreaks are as follows: Preventing the free circulation of warm winds and consequent exposure to cold; injuries from insects and fungous diseases; injuries from the encroachment of the windbreak itself; increased liability to late spring frosts in rare cases.

a. The injuries from cold, still air is usually confined to those localities which are directly influenced by large bodies of water, and which are protected by forest belts. It can be avoided by planting thin belts.

b. The injury from insects can be averted by spraying with arsenical poisons.

c. The injury from the encroachment of the windbreak may be averted, in part at least, by good cultivation and by planting the fruit simultaneously with the belt.

4. Windbreaks are advantageous wherever fruit plantations are exposed to strong winds.

5. In interior places, dense or broad belts, of two or more rows of trees, are desirable, while within the influence of large bodies of water, thin or narrow belts, comprising but a row or two, are usually preferable.

6. The best trees for windbreaks in the north-eastern states are Norway spruce and Austrian and Scotch pines, among the evergreens. Among deciduous trees, most of the rapidly growing native species are useful. A mixed plantation, with the hardiest and most vigorous deciduous trees on the windward, is probably, the ideal artificial shelter belt.

L. H. BAILEY.

FORESTRY FOR CANADA.

BY H. G. JOLY DE LOTBINIERE.

The forest does not only supply the invaluable commodities of fuel and lumber, it exercises a great influence on the climate, and on agriculture. If science has not yet admitted that the presence of forests increases the rainfall (by condensation of vapour held in the atmosphere, owing to the lower temperature of the forest land, or by other means) it is universally admitted that the forest regulates, throughout the year, the distribution of water in our streams, contributes to retain the moisture favorable to vegetation, retards evaporation, and checks the effects of drying winds.

Unfortunately, it is only after the forest is gone, that its value is truly appreciated, as in the south of France, Spain, Italy, Greece and many other countries, once fertile, now barren and unproductive. The two great extremes, long drought and disastrous inundations, are due to the same cause, viz.: the wholesale destruction of the forests, especially on the mountains, the birthplace of the streams. The soil of many a fertile valley is now hidden under a thick bed of sand, gravel and boulders (as we often see in Switzerland) brought down by torrents from the mountain slopes, where the trees which once retained the ground with their roots have been destroyed. The rain, instead of soaking gradually through the moss, vegetable mould and roots, and feeding, by degrees, the springs and streams, as it did while the forest lived, rushes down to the valleys below, as it falls, as from the sides of a roof, in irresistible torrents, carrying with it the ground that nothing now retains on the steep mountain side.

It is most interesting to follow the work of re-afforesting carried on, principally in France, on the Landes for nearly a century, and on the barren mountain slopes, and to notice their beneficial results. The efforts of the "Ligue du Re-

boisement de l'Algeria" to repair the harm done in Algeria, by the burning of the forests on the slopes of the Atlas, deserve the warm sympathy of all those who can appreciate perseverance and devotion to the public good.

But the subject before us to-day, is "Forestry for Canada." It is difficult to awaken any interest in the question among us. We are apt to consider Forestry as a superfluity, here, as if our forests were inexhaustible. They would be so (saving accidents by fire) with judicious management and sufficient protection. The aim of Forestry is not, as many believe, to preserve trees forever, or until they decay and fall. Quite the reverse; it is to select and cut down every tree ripe for the axe, making room for the young growth, and thereby insuring a continued reproduction and a steady revenue. As it is, we are not only spending our revenue, we are drawing largely every year upon our capital.

The pride of the Canadian forest, the white pine, is getting very scarce; the proportion of first-class wood is decreasing year by year, while the distance from which it is brought is increasing. How many mill owners, who would have scorned sawing spruce logs a few years ago, are only too glad to get them now, and though spruce reproduces itself much more readily than pine, we can foresee the time when it will get very scarce, at the present rate of cutting.

The late James Little, of Montreal, who was the first to sound the alarm, deserves to be gratefully remembered by Canada. When every one treated our pine as if the supply were inexhaustible, he was the first to call attention to its rapid disappearance. His warnings were met, not only with indifference, but with ridicule. Now, the eyes of the most sceptic are opened, and they must admit that he was right; but it is sad to see them turn around now and affirm that it is no use devising means for the protection of our forests, because there is nothing left in them worth protecting. There is still a great deal left worth caring for and improving. It is late, but not too late.

It is a good sign to find in the Dominion Statute Book, 47 Vict., cap. 25, sec. 5, proof that the importance of preserving the forests on the Rocky Mountains is well understood. The Governor-General-in-Council is empowered to make provisions "for the preservation of forest trees on the crests and slopes of the Rocky Mountains, and for the proper maintenance, throughout the year, of the volume of water in the rivers and streams which have their sources in such mountains."

In the absence of a regular system of Forestry, there are practical means of protecting our public forests which I will now review as briefly as possible.

A careful *classification* of public lands, under two heads: lands fit for agriculture, which alone ought to be open to settlement—lands unfit for agriculture, which ought to be carefully closed against settlement and kept in forest. The best timber lands, especially the pineries, are generally totally unfit for agriculture; it is a cruelty to decoy settlers there. How many hard working men have wasted the best part of their lives in trying to get a living out of such poor soil, and are tied down to it for want of means to move away with their families; the only result of their work being the ruin of a fine forest and their own ruin. The Quebec Legislature had enacted a wise law in 1883, the Timber Reserve Act, which, I regret to see, is on the point of being repealed. As to the relations between the settler and the lumberman, where there is good faith on both sides, those relations ought to be of the most friendly nature.

Strict regulations as to the *minimum* size of logs allowed to be cut, and encouragement to convert trees into saw logs, instead of square timber, which wastes one-third of the tree in the squaring.

Protection against fire which destroys more trees than the axe, precautions in lighting fires in the woods and in clearing lands by fire, for settlement; this

last subject is closely connected with the question of the *classification* of lands and keeping of settlers from lands unfit for agriculture. Fires are more to be apprehended in pineries and among resinous trees, where the soil is very often unfit for agriculture, than among hardwood trees where the quality of the soil is much better as a rule. Our Provincial Legislature is now considering a good measure calling on the lessees of timber limits to contribute one-half of the costs of protecting their limits against fires, the Province paying the other half. It is, I think, the law in Ontario.

CREATION OF NEW FORESTS.

It is difficult to compress within the narrow limits of one article all the branches of Forestry. After considering the preservation of existing forests, we cannot ignore the necessity for creating new ones, on the prairies of the North-West and our old settlements, denuded of trees, in the East.

As for the North-West, what we want, first of all, is *practical experience*. Many theories have been propounded to explain the absence of trees on the prairies, and Mr. A. T. Drummond, of Montreal, a zealous worker in the cause of Forestry, has written some very interesting essays on that subject.

I would recommend the *Ash-leaved Maple*, for the prairies to start with. The rapidity of its growth, its resistance to the drouth, the value of its sap for sugar, which has been scientifically demonstrated by Doctor B. J. Harrington, in a series of experiments, the results of which have been communicated by him to the Royal Society of Canada, in a most interesting paper; all these recommend its culture as a starting point. With that tree plant cotton-wood, poplar, willow, every kind of fast-growing tree, however inferior in quality, so as to start wind screens, behind which slower growing but more valuable trees can be cultivated, and fields of grain sheltered from the baneful effects of the drying winds.

If, in the absence of any serious attempts at forest tree culture in the North-West, we are still puzzled how to proceed there, here in the East, we know beforehand that we are bound to succeed, with proper judgment and care. We know that every soil here, whatever its nature, can grow some kind or other of tree, and that, in many instances, the intrinsic value of the tree is quite out of proportion with the value of the soil: pines on sandy soil; sugar maples on rocky hill sides; ash on cold, wet soil; tamarac and cedar in swamps; white birch on the worst soil and under most unfavorable climate, and, of course, oak, elm, butter-nut, black birch, &c., &c., in good soil.

It appears logical to choose the most valuable of trees for a new plantation, when the nature of the soil admits of it, though we often see valueless willows and poplars planted on the best soil and even in gardens. I have tried the black walnut, which sells for a dollar a cubic foot, in Quebec—nearly the price of mahogany. Trees raised from the nut have given me nuts after twelve years growth, but, as my experiments do not extend over fourteen years, however satisfactory to myself, I cannot yet assert that the success is complete. Certainly it is very encouraging, and, I hope, will lead others to try the experiment, which is not an expensive one.

It is impossible to enter into the details of tree planting now, but there are two points which ought not to be overlooked: in our climate, experience shows that it is better to plant trees in the spring, especially if the soil is in the slightest degree wet or even retentive of humidity, and consequently affected by the frost, and, secondly, it is useless to attempt tree culture *without good fences*, as cattle will destroy all young trees. In fact, there are thousands of spots where the cultivation of the soil has been given up, which, in a few years, would be covered with a growth of self-sown trees, if the cattle were only kept out by fences

The results of Forestry are so far removed, and, at the same time, of such national importance, as to make it incumbent on the Government to encourage it by every means; experimental stations, especially in the North-West, in charge of the Mounted Police and the Indian Agents and teachers, nurseries of forest trees and gratuitous distribution of the same, rewards in land grants or exemptions from taxation; encouraging the observance of Arbor Day, a school of Forestry, or, until that point can be reached, sending some well-qualified young men to study forestry in the French and German schools, and last but not least, educating the people, beginning with the children.

Teach, in all the schools, the elements of tree culture, joining practice with theory, whenever possible. No better way to develop in the child the qualities necessary to his success as a man. He will learn forethought, in choosing the proper season, the soil, the tree; care and patience in digging up and transplanting that tree; perseverance in watching over it, watering it, supporting it, pruning it, cultivating the ground round it; unselfishness, in feeling that he works not only for himself, but that others will enjoy the fruits of his labor.

The article, by M. Joly, from which the above is taken, was much longer, but I have copied the most interesting and the largest part. He objects also, principally I think referring to his own Province, to large sales of lumber limits in advance of the requirements of the market. It should be observed, however, that there often exists especially where large main lines of railroad have lately been run through a country, a good reason for selling the right to cut timber on these lands. They are often in great danger of being over-run by fire. Selling the lumberman the right to cut timber places the forest under his protection. It becomes his direct interest to use every possible means to preserve it from fire. For many years in Ontario, he had little chance, but now, as the Ontario Government pay half the expense of what fire-rangers the lumberman chooses to nominate, the means are ready to his hand. He is assisted, too, by the fact that a large number of these rangers are yearly, in the dangerous season, stationed in forests near his own, thereby rendering the running of fire much less likely.

AN EXAMPLE FROM KANSAS.

The following letter by S. C. Mason, Esq., Kansas, to "Garden & Forest," will be found in many passages interesting and valuable to Canadians. One sentence which says: "A slaughter like this is often made to secure one more field for corn or wheat, and this by a man who has already more acres under the plow than he can bring to one-half of their productive capacity," is peculiarly applicable to Canada, where over many thousand acres, the same class of injurious labor has been performed. Another is equally applicable; "When cattle are not allowed to tramp out the young seedlings for the scanty pasturage furnished by the woodland, the value and profit of Kansas forests will steadily increase":--

KANSAS FARMERS AND KANSAS FORESTS.

SIR,—Though Kansas possesses no timbered area that, for extent or density, will compare with the forests of the eastern or middle states, there is a consider-

able extent of country along the eastern border which was originally well clothed with trees—in the bottoms a heavy and valuable growth, on bluffs and uplands a scattering stand of scrubby oaks and hickories. Farther west the timbered area is narrowed and confined more closely to the streams, and beyond the junction of the Blue with the Kansas River the last wooded hills are seen. Beyond this point the trees on the slopes of the bluffs disappear, and only the banks of the streams and the lower benches are wooded. Before the head waters of either of our larger western rivers are reached, the last solitary cottonwood or elm will have been passed and the buffalo grass and the blue-stem are masters of the field.

The trees are not keeping their bounds without attempting to acquire territory, and every rod of soil where the fires cannot sweep is sooner or later covered with timber. A bend of a stream nearly surrounding a bit of bottom land affords the best chance for an advance if the fires are prevented from entering from the unprotected side. Where natural conditions or the care of man afford this protection, we soon find those advance guards of forest-growth, the sumach and the dog-wood bushes, springing up among the blue-stem grass. Before long from the midst of these thickets young oaks, walnuts and elms shoot up, and in a score of years form a handsome grove. Out along some narrow ravine or draw leading down from the bluffs the trees push their way, year after year, where fires have failed to reach them. Then comes a wet season, with an unusual growth of grass, a dry day, with the wind in just the right direction, and the fire sweeps down deadening the young growth back nearly to former limits. But the sturdy roots are left alive and the contest is renewed till, at length, the trees overshadow and drive out the grass, and so deprive the fire of fuel.

With the general settlement of the country came the steam saw-mill and the demand for all grades of native lumber, as well as for thousands of loads of stove-wood. Many of the owners of timbered lands, reckless of the future, sold their trees till not a valuable stick was left. The trees that stood upon the land of a non-resident or upon state or school lands were chopped and plundered by day and by night. Cases could be cited in some of the western counties where a fine growth of red cedars was so completely cleared from the bluffs that neither stumps nor roots now remain in the chalky declivities to give a hint to the verdure that once covered them. Kansas pioneers dealt with the scanty growth of timber they found with the same reckless disregard for the future which led to the extermination of the white pine farther east. Those who settled first and secured timber claims had more than enough wood for their needs; the prairie homesteader had none. It is perhaps not just or consistent to blame too severely these early pioneers who came to the state often with little besides the team and waggon which brought them. With the nearest railroad station fifty or a hundred miles away, where pine lumber of poor quality could be had only at enormous prices, it was natural that as much as possible of the native timber should be turned to account. But there is a waste and destruction of young timber taking place to-day against which the warning voice cannot be too earnestly raised. It may sound strange to speak of clearing timber land in Kansas, yet it is a fact that within a single county, during the past few years, many acres of thrifty young timber have been chopped and placed on the market as stove-wood or fence-posts. I have seen scores of young black walnut trees, not thirty years old, split into rails and fence-posts, without a thought on the part of the owner that the supply of merchantable walnut lumber in the east and south is nearly exhausted, and that he was clearing the ground of trees which would be of great value to his children. A slaughter like this is often made to secure one more field of corn or wheat, and this by a man who has already more acres under the plow than he can bring to one-half of their productive capacity.

When the farmers who own the timbered lands make it a rule to cut only matured trees or crowded and imperfect ones, except when needed for special use, thinning judiciously and preserving with care every young tree of a valuable variety; when timber lands are as carefully guarded from fires as the stock-yards and stables, and when cattle are not allowed to tramp out the young seedlings for the sake of the scanty pasturage furnished by the woodland, the value and profit of Kansas forests will steadily increase.

The future of Kansas forests must rest with Kansas farmers. Give the trees protection from fire and stock, with a little timely thinning and pruning; cut them as they reach maturity, and provide the way for others to take their places, and the woodlands will grow continually more valuable and yield a return as safe and sure as the best plowed fields.—*S. C. Mason, in "Garden and Forest."*

THE RE-AFFORESTATION OF IRELAND.

Any one who, passing along the Irish Channel, has viewed the bare and desolate appearance of the Irish coast, there presenting a high mountainous range, can easily see how much the country needs the shelter of its ancient forests, of which it has long since been deprived. Every depression, shielded by the hills, is cultivated, but all between, where the wind sweeps unchecked over the land, is a succession of uncultivated expanse, where nothing or nothing but the poorest pasturage exists. The following proposals for re-foresting Ireland will interest my readers—having a direct bearing on the necessity of planting waste portions of land, of which many exist in Ontario:—

At the invitation of the late Dr. Lyons, M.P., though at his own expense, Mr. Howitry, who holds the office of forest conservator in Denmark, examined the resources and the need of Ireland for forest cultivation. He surveyed its mountain ranges, its moors, its lakes, and its rivers. His experiences and conclusions he has embodied in a report to Dr. Lyons, which has been published as a Parliamentary paper. His deliberate judgment agrees with the surmises which had already been formed. Swamps and morasses are created in Ireland from the want of trees to drink up the superfluous moisture. Irish rivers inundate the districts they traverse because there are no forests on the mountain tops to arrest and retain the autumn and spring rains. In summer there is a dearth of water because the trees are gone which would have served each as a reservoir. A tree is advantageous in a double way: it is like a camel in its power of imbibing an enormous quantity when water is abundant or superabundant—like a camel it keeps the store for a time of scarcity. Irish agriculture, by its system of straight drains, which Mr. Howitry entirely disapproves, has acted as if water were poison instead of nutriment. In the past by felling the mountain woods, and in the present by planting no successors, it has done worse by tapping the supply at its source. Irish fruitfulness, he warns the nation, is gradually being drained and washed away into the lakes and seas, and no preparation has been made to replenish it. The folly is, in his estimation, the more inexcusable that the islands presents the especial conditions for rendering forestry easy and beneficial. On the hills the soil is still able to feed all the trees which can be put into it. Out of the 20,000,000 acres in Ireland he reports that there are at least 5,000,000 for the most part waste, which might be planted with a reasonable certainty of profit.

Irish wastes on the mountains and in the valleys are, he considers, of a different order of fertility altogether to the Landes, or the Pyrenean and Alpine slopes, on which re-forestation is being conducted with indisputable gain. Ireland would, he is persuaded, grow valuable timber, instead of commoner and cheaper kinds. A list, appended to his letter to Dr. Lyons, enumerates 36 conifers, 38 deciduous and hardwood trees, and eight sorts of bushes which could be grown to advantage. The varieties could be selected with regard to the readiest local uses for the wood. He has drawn up from personal inspection an elaborate scheme for planting at least 100,000 acres every year for the next thirty. At the end of thirty years a plantation, he reckons, comes to full productive capacity, without respect to the previous incidental returns from brushwood and saplings. At thirty years of age, he calculates that the cost per acre will have been, at highest £20, the average annual profit at lowest £1. Probably as the demand for timber, of which England yearly imports 290,000,000 cubic feet, is rising, and the area of supply continually narrowing, the profit may be much larger. At present most of the 5,000,000 acres of waste pay not a penny of rent; the residue yields less than sixpence an acre.

SOWING TREE SEEDS.

During the year there have been frequent enquiries from amateurs who wish to grow their own tree seeds, as to the best methods, a piece of information not always easily obtained. The following essay, contributed by one of our most practical Toronto planters, gives such full and exact information as to render it well worthy of publication:—

For this purpose select a piece of land naturally dry, in good clean condition, just such a piece as any good farmer would consider capable of growing a good crop of anything on the farm. The soil *must be* on top a sandy loam. This is absolutely necessary, for this reason: sandy soil is not subject to upheaval by frost as are clay soils. Seeds sprout through a sandy covering easier than through clay, as this last frequently cakes into a hard crust which it is almost impossible for the young seeds to push through unless the crust is broken carefully with the fingers or an instrument—a delicate job, and no matter how carefully done, sure to be fatal to many of the young shoots alike in all nut seeds, which resemble in a measure young beans, and are equally brittle in their formation. Where it is not possible to have a seed bed of a light sandy loam, and a person has to sow on clay, be sure and cover the seed in the drills it is sown in, and fill the drills to the surface with sand brought for the purpose. It does not matter what the quality of the sand is. A sand the same as builders use will answer capitally. A piece of land selected for a seed bed should be deeply ploughed or dug; the surface should be even, and not too flat, so that no water will remain to cause stagnation, among the nuts or seed. When all is ready, make the drills the full width of the hoe, which would be about six inches, and about two inches deep. Now sow the nuts thinly,—large nuts, as walnuts, horse chestnuts, etc., about four inches apart in the row; acorns and smaller ones a little thicker, but as the aftergrowth is about the same, the same distance will answer. Cover evenly with soil, and tread the drill firmly. For sowing tree seeds the feet are as useful as the hands. I place great stress on this treading the soil, as this places the nuts firmly in the land and also makes sure of covering the soil over them. After the drills have been tramped rake the loose soil evenly

over all. A proper distance apart between the drills would be twenty inches. This distance gives convenience in weeding and hoeing the drills, as all the cultivation of seedlings must necessarily be done by hand. In reference to how deep seeds should be sown, a safe rule is to place the covering of soil twice in thickness the diameter of the seed, so that while a chestnut would be covered with two inches of soil, a beech-nut would have about an inch, and so on in proportion. There are always exceptions to rules, and what a person should strive to attain is a happy medium. Allowance must be made when sowing the seed for the loose soil to settle so that the seed may be always covered a little more, as the subsidence of the soil will bare the seed more or less. And now I come to the chief factor of success in growing seedlings, and that is mulching. So long as the seed-bed is covered after sowing with a good mulching of any litter, manure, leaves, straw or stalks of any kind, success is certain. As to covering the seeds in the drills, should any mistake be made about not putting enough soil, the mulching will put all right. In fact, seeds sown on top of the ground, if only mulched, will do well. This mulching should be left on the bed till warm spring weather sets in, or an examination of the seed-bed shows the seeds pushing their tender shoots through the ground. Rake the mulching into the space between the drills, where it may be left if of a fertilizing nature; here it will keep weeds down and the soil moist. If, however, it be of a bulky nature, and might impede the growth of the seedlings, have it removed and commence the cultivation of the seedlings the same as you would a crop of carrots,—hoeing, weeding, etc.

We have now the seeds growing and the first season passed over. In the seed-bed plants of maple, ash, birch, chestnut, elm, and all fibrous-rooted trees, may be left two years; but as the roots on all nut trees are tap-rooted, it is necessary to take them up the following spring if they make any vigorous growth. If they do not, then you may leave them two seasons, but no longer. Another reason for not disturbing the seed-bed too soon is that very often the seeds lie dormant the first year, and come up the second. The seed of the ash will sometimes thus remain dormant. After two years of growth in the seed-bed our seedlings will be ready for transplanting. As early in the spring as the ground will allow for digging, have the seedlings dug up. They should be assorted into two sizes, the large and the small. With a sharp knife, cut the leading and tap-roots back to within six inches of the collar. Do not touch the tops at all, tie them up in convenient bunches for handling, dip the roots in thin mud, and heel in ground convenient to your work. The best soil to grow all kinds of trees in nursery rows is what is known as a sandy loam with a clay bottom. Select a piece answering that description and have it prepared as for any farm crop. To prepare it properly, it should be summer-fallowed the season previous, but that is not necessary though desirable, as any land in fair tilth will answer. Having it ploughed and harrowed, set the line parallel with the longest way of the lot, if most convenient to cultivate that way. A good strong garden line is the most useful and indispensable article in the planting of trees. The line set, level all inequalities of the soil with the spade under the line, and pat the soil down firmly by striking with the back of the spade on the line. The next operation is to cut out the drill by striking with the edge of the spade parallel with the line run, as it were to split the line. A little practice will make a handy man very expert and exact in cutting the line, as it is termed in nursery parlance. The drill is now dug out a spade wide and the soil put neatly on the opposite bank from the line—the bottom of the drill being evened with the spade as the digger goes on digging out the drill. All is now ready for planting, and the planter, provided with a bundle of plants, stoops and places a seedling neatly against the bank, placing the collar of the root neatly against its edge. Another person at

the same time places a spadeful of soil with a quick turn of the spade snugly and securely against the roots of the plant. So the planting goes on, and as the planters get more expert, they can place the plants as fast as a slow walk, as we might say, to use a paradox. The plants want firmly treading and straightening, and the balance of the trench may be filled in and levelled off. A convenient distance for any kind of forest tree in the row would be one foot apart, and the distance between rows, four feet. This allows cultivation with cultivators and single plough by horse and man, and is in every way convenient for growing trees straight and in good shape. Out of these rows the trees may be transplanted at any time, spring or fall, to other places, or if the idea is to leave them there permanently they will succeed. After growing three or four years, every second tree may be dug up and transplanted. After four or five years' growth every second row may be removed entirely, thus leaving the rows eight feet apart, and trees two feet apart in the row. In this arrangement on fair soil the trees may be left to grow to form timber or wood. The strongest will now survive, and any weakly ones can be removed at the option of the cultivator. I again repeat that very little experience, with an observant mind, will soon teach a person how to grow and manage the trees for forest cultivation. Before mentioning anything further connected in a general way with tree growing, I will return to group No. 2, consisting of elms and maples, ripening their seed in June. As soon as these seeds are beginning to flutter to the ground the main crop will be found ripe enough for gathering. As these two trees are two of the most important classes of trees we have in our whole list of forest trees, having so many qualities in the value of the timber for firewood, lumber and every other use to which these useful trees may be applied, the importance of their position in the landscape of the country, and many other qualities, had we time to mention them, it is a great blessing or boon to know that they reproduce freely from seed, also that the trees bear great quantities of seed, also that they ripen early in summer, in time to allow of the seed being sown there and then, and that it grows the same season, making a foot or more of growth the one season. The same directions as mentioned before are now applicable to the elm and maple seeds. I must repeat, when sowing the seed be sure and tread it in firmly—the same distance apart in the rows, and after cultivation, as mentioned before in connection with transplanting, etc.

GENERAL CONSEQUENCES OF THE DESTRUCTION OF THE FORESTS

BY MR. MARSH.

With the disappearance of the forest, all is changed. At one season, the earth parts with its warmth by radiation to an open sky—receives, at another, an immoderate heat from the unobstructed rays of the sun. Hence the climate becomes excessive, and the soil is alternately parched by the fervors of summer and seared by the rigors of winter. Bleak winds sweep unresisted over its surface, drift away the snow that sheltered it from the frost, and dry up its scant moisture. The precipitation becomes as regular as the temperature; the melting snows and vernal rains, no longer absorbed by a loose and bibulous vegetable mould, rush over the frozen surface, and pour down the valleys seaward, instead of filling a retentive bed of absorbent earth, and storing up a supply of moisture to feed perennial springs. The soil is bared of its covering of leaves, broken and loosened by the plough, deprived of the fibrous rootlets which held it together,

dried and pulverized by sun and wind, and at last exhausted by new combinations. The face of the earth is no longer a sponge, but a dust heap, and the floods, which the waters of the sky pour over it, hurry swiftly along its slopes, carrying in suspension vast quantities of earthy particles which increase the abrading power and mechanical force of the current, and, augmented by the sand and gravel of falling banks, fill the beds of the streams, diverts them into new channels and obstruct their outlets. The rivulets, wanting their former regularity of supply and deprived of the protecting shade of the woods are heated, evaporated, and thus reduced in their summer currents, but swollen to raging torrents in autumn and in spring. From these causes, there is a constant degradation of the uplands, and a consequent elevation of the mineral and vegetable matter carried down by the waters. The channels of great rivers become unnavigable, their estuaries are choked up, and harbors which once sheltered large navies are shoaled by dangerous sand bars. The earth, stripped of its vegetable glebe, grows less and less productive, and, consequently less able to protect itself by weaving a new network of roots to bind its particles together, a new carpeting of turf to shield it from wind and sun and scouring rain. Gradually it becomes altogether barren. The washing of the soil from the mountains leaves bare ridges of sterile rock, and the rich organic mould which covered them, now swept down into the dark low grounds, promotes a luxuriance of aquatic vegetation that breeds fever, and more insidious forms of mortal disease, by its decay, and thus the earth is rendered no longer fit for the habitation of man.

GERMAN FORESTRY.

A writer in *Woods and Forests*, London, England, speaks thus :—

I have observed that the Germans, though they have a vast growing population, nevertheless have preserved most carefully all the forests on their principal hills, that is to say, in the upper basin of the Rhine, of the Elbe, and in many other places. Their forest preservation is a model for all other nations. They do it not for climatic reasons, but for the preservation of the national wealth. The same remark applies in Eastern France, that is to say, to the Vosges Mountains, in the arena which was the scene of the Franco-German War. There is also Nancy, which is the great forest school of France. I am not here in any way to pronounce a defence of or a panegyric upon the administration of the late Emperor Napoleon the Third, but whatever may have been his faults of ambition, nevertheless he was one of the first men in France to introduce a system of sound forestry in that country. This has been done in Eastern France for the preservation again of the national wealth, rather than for climatic reasons. Now I have referred to three countries—Scandinavia, Germany, and Eastern France, all of which maintain their forests for the national prosperity, and for the supply of the markets of the world. It is very lucky for us in Great Britain that there are such sources of the supply of foreign timber. We get our timber, as you know from Scandinavia and Canada.

The art of Forestry is cultivated in some other countries I am about to mention, not only for the augmentation of the national wealth, but also for the sake of preserving the moisture and fertility in the soil, and for maintaining a temperate climate. For ensuring a temperate climate to the inhabitants, the first to be mentioned is Southern France. The guide-books most familiar to tourists tell of the immense injury wrought in Southern France by the destruction of the forests

which used to exist there. In consequence, the ground has been washed and carried away, and barrenness succeeds to fertility. Then you have long periods of drought, followed by floods and inundations, many of them being greatly destructive of life and property. This has notoriously been the case in Southern France, as it has also been in Italy and in Spain. I fully believe that the destruction of forests in Spain is as great as anywhere in Southern Europe.

We know that Russia is a country of forests naturally. But if you travel there you will find that birch forests have largely succeeded to the pine. This means that where pine forests have been cut down without any provision for reproduction, birch forests grow up. Whenever you see a birch forest there, you will know that a reckless, unscientific felling of pine trees has occurred. This has, no doubt, affected the climate; the alternation of drought and flood is more frequent than it used to be between Moscow and Odessa. Come to the next neighboring country—Turkey. Around Constantinople the destruction is patent to all travellers. Upon both shores of the Bosphorous the population has hardly a stick to bless itself with. Then sail down to the Levant. It was once the scene of the greatest events, and a region most blessed with wealth and fertility. It is now merely a shadow of what it was. The harbor of Ephesus has been dried up from the silting caused by deforesting on the adjacent hills; and crossing over to Cyprus, one of the latest regions to pass under British sway, there again you hear of nothing but destruction of forests. The goat-herds of Cyprus have carried the day, and innumerable goats are still allowed to browse upon the young plants with but little restriction; and the sylvan glories of Cyprus are now departed and merged into darkness. Then again, cross over to Syria, the opposite shore, and you hear the same story there. Where now are the famous cedar groves which existed in the days when Hiram sent timber to Solomon in Palestine? There are only a few clumps of trees to mark what once was there. Where are the oaks under whose shade the patriarchs pitched their tents? Echo answers, "Where?" Only a few remnants remain. I believe the only forests yet remaining within the old sacred limits of Palestine are a few of the Oaks of Bashan. But they are situated on the other side of Jordan, where the hand of destruction cannot reach them. Next pass on to Persia. Why, Persia used to be an enormous Empire, but now-a-days it is a decayed country. Where are no wthe vast populations it used to feed? They have shrunk down to a pretty figure of some seven or eight millions. This is, of course, mainly owing to the destruction of the forests. Alas! the forests are gone, the streams are dried up, and though the old water channels remain, they may be very useful to the antiquary, but are not useful to the political economist.

IMPOVERISHMENT OF LAWN TREES.

The following from an English writer may commend itself to the owners of lawns and parks in and near Toronto. I know no other place where the need of both grass and trees are so glaringly disregarded:—

This is a subject meriting the most serious attention of all planters, and the yet larger numbers that feel an interest in the well-doing of trees on grass. Such trees are impoverished in two ways chiefly, the grass grows at their expense, and they are deprived of nature's annual enrichment in the form of dead and dying leaves, weeds or grasses. The results of these compound robberies of the roots, prove most disastrous to the trees. So marked, often are these starving effects

that by the time the trees reach middle age, or stature, they have begun to look prematurely old, or have already given way under disease; moss or lichen have crept up under their limbs and branches, adding, it may be, a new beauty to some trees, but also providing snug lurking places for insects, and inviting the attacks of disease. True, ungenial or wet soils may often bring trees down into similar states of decrepitude or premature old age, but for every tree that becomes diseased or dies through ungenial soils, a score or more perish of sheer starvation. Of course, on good soils the process is slower, as the roots bore deep and run far; but no soil can thus keep on giving out its goodness day by day, month by month, and year by year, and receive nothing in return without becoming finally exhausted. As if these two main causes of impoverishment were not sufficiently mischievous, not a few cultivators still further worry their trees at top, and impoverish their roots at bottom, by the weekly shaving off and carrying away of all the grass that grows under them. The grass is grown largely at the expense of the roots, and, were it left to decompose where it grows, this would partly recoup them for its production; but the incessant mowings and removals prove double drains on the soil; the removal of the crop balks nature's effort to compensate it for its production.

Fallen leaves were certainly meant to protect and feed the roots of trees. The quantity that falls, even in the case of conifers, is wonderful. Under some of our trees, such as *Pinus insignis* and *Sabiniana*, barrow loads of needles might be gathered up yearly. Left where they are, they prove an impenetrable barrier to frost. As to their unsightliness, very few of them will be seen by the end of April, and, besides, the lower branches in most cases cover them up from observation. The fallen leaves perform another useful service: they kill or prevent the growth of the grass. By forming a layer of porous debris on the surface, the free passage of water to the roots is ensured, while these natural mulchings hinder the evaporation of the moisture or strength of the soil. Of course, the wide spread of the bottom branches of trees likewise assist in most of these useful purposes. They keep the roots from being frozen and protect them from sun scorching or air drying. In any case where it might be undesirable to prevent the impoverishment of the roots by such means, some other methods of recouping them should be devised. There are few better modes than the application of an occasional top-dressing of good soil or rich compost, according to circumstances. Those who prefer a surface of soil should keep it rough and loose. But cocoa-nut fibre refuse is more sightly, as well as far more useful than any kind of earth as a top-dressing for single trees. Some recommend well-rotted farm-yard manure. There is no objection to this for the majority of deciduous trees, though it must be employed sparingly, if at all, for coniferae. Good loam forms the most suitable top-dressing for these, though, if planted in fairly good soil, and trained and treated as here recommended, their own leaves will generally prove a sufficient top-dressing to maintain them in sufficient vigor and preserve them in robust health. In a garden, all waste soil, such as old potting-moulds, should be saved and used as top-dressing for conifers, it being one of the best tree fertilizers.—F.

There is a park in Toronto which one might think was in the remembrance of the writer when he wrote the foregoing piece. It is not rich land—it never was—it might have been, but every care has been taken, as long as I can remember, to prevent it becoming so. Once it contained many beautiful young trees—a time, I remember, about forty-five years ago. It had a tolerably rich sward of the roughish clumpy grass which sandy land often gives, but that I think is

now poorer than ever ; while, the trees, that is the pines, which, being now, I should think, about seventy years old, should now be in full rich growth, are dying at the top already, while the deciduous trees are very far from being what they should be.

This has been deliberately done—every year vast quantities of leaves have been piled in heaps and burned, leaving behind, for manure I suppose the managers intended, a thin layer of wretched ashes. The real manure had, of course, gone in black volumes of smoke to the skies. It might have been a beautiful sward dotted here and there with magnificent trees. It is in many parts as bare as a Cumberland side-hill. Why, putting the matter of leaves to one side, they brought manure there by the thousand cart loads. What did they do with it ? There was, where beauty most was wanted, in full view of the principal building, a beautiful stretch of low ground backed by an extensive grove. They took all this manure, with a vast amount of other earth, mostly rich, and filled up the hollow level, sodded it over and made the whole thing look as flat as a Dutch garden of the last century. Now, the vast mass of earth and manure with which they perpetrated this piece of vandalism would, if properly spread and mingled with grass seed, have fertilized the whole park, both grass and trees. Nay, if all these years they had simply composted the leaves and spread the compost, that would have done as much for them. But what can you expect ? I have seen them in a park near Toronto, which, left alone, would have been a beautiful one, prune—actually prune—beautiful spreading pine trees, sixty feet high, nearly to the top.

INFLUENCE OF ASPECT, WINDS, AND SOIL, ON GROWTH OF TREES.

The influence of aspect upon the growth of trees depends something upon the prevailing winds and other causes. But soil, slope, and other conditions being otherwise the same, we may state the effects of aspect approximately as follows :—

The northern aspect receives no sun, or but obliquely, according to the angle of elevation. The winds are colder and dryer, and generally in the growing season not strong. The soil retains its moisture, and the growth of vegetation is rapid. The trees retain a more regular shape and their tissues are softer. The timber is, therefore, not as strong, but it is very well adapted to manufacturing purposes. The later vegetation on the north slope delays the opening of buds, and reduces the risk from late spring frosts ; but from the late hardening of summer growth, some injury may occur from freezing in winter. The snow lies longest on this slope which very materially favors forest growth. The starting of a forest by seeding is more easily secured on a north slope than any other. It was on a northern slope only that forest seeds sown upon the damp snows in the works of replanting the mountain regions of the Alps, by the French Government, were found to succeed.

The eastern aspect receives the direct rays of the sun in the cool morning hours, and the temperature and light are moderate. The winds (in the United States) are often damp, especially in winter, and the trees seldom become loaded with ice, except when the eastern winds are blowing. The soil holds its moisture fairly, and the timber grows well and acquires medium qualities that adapt it to the greatest variety of uses.

The southern aspect receives the direct rays of the sun, and the light and heat are both intense. It is liable to winds and storms and to erosion from rains, because from the heat a protecting growth of herbage is less liable to be found on the soil. The trees have, on the whole, a slower growth and less regular form, but the timber is firm, heavy and strong, well adapted for building and manufacturing purposes. Seeding can seldom be secured on an open exposure to the south in a warm climate, and trees must usually be set and attended with greater care.

On the western slope the sun shines obliquely, but in the hottest hours of the day, and in our Western States, vegetation is most exposed to drying south-westerly winds. The soil is liable to become dry, and timber is of relatively slower growth and of inferior shape, but the quality in the main is good. These differences are often but shades that would, at times, be scarcely observed, especially in isolated hills; but at other times would be strongly marked, especially when a long trend of hills or mountains gave these influences their full effect, and would be most apparent when the slope in this case are north and south, when the differences amount to contrasts that would attract the notice of a casual observer.

To this may be added that the influence of aspect upon the growth of the trees depends in a great measure upon the prevailing character of the winds, as to whether they blow from the sea or the continent, and whether they have been deprived of their moisture by passing over high mountains. It is, therefore, impossible to state a general rule, but, as a general fact, the firs, pines, arch, and birch, prosper in a northern aspect; the locust, beech, hornbeam, and birch on the eastern slope; the oak, maple, and chestnut, on the southern; and the spruce, oak, beech, and hornbeam, on a western one. It is probable that the effect of prevailing winds is more felt than the differences of exposure to the sun, unless the slope be so steep as to shade the surface. The authority last cited notices a difference in quality of the wood, according to the exposure in which it grows. The north-east, east, and south, are the best, and the north-west is the poorest, because trees growing with that exposure are most liable to injury from frost.

The quality of wood is also influenced by climate and by the dryness or humidity of the soil. Timber grown in a soil where there is stagnant water for part of the year is apt to be of coarse, loose, and spongy texture, and weak and tender as to strength. But if the roots are supplied with sufficient moisture, without excess or deficiency, the wood is dense, hard, and elastic. The best quality of wood is grown on good soil properly drained. Granitic sand or gravel with a subsoil which the roots can penetrate and from which they can obtain nourishment, will often bear timber of fine quality, even where the surface is not profitable for agricultural use. The oak grown in a thin soil upon a flat rock has usually a large percentage of sap-wood and a little fibre. Timber grown in isolated places does not, as a general rule, split as easily as that grown in dense forests. Other conditions being equal; the density of wood grown in the south of France is greater than that from the northern departments. The tropical woods of exogenous families are, as a rule, distinguished by their great weight. This circumstance prevents them from being floated upon rivers unless buoyed up by air-vessels or other means.

STAKING TRANSPLANTED TREES.

Most of my readers can, no doubt, stake a tree properly, but still it is a matter concerning which there is often something to be learned. With whatever you support a tree the bark is likely to fray or chafe at the point of junction. On the other hand, we can tie it so tightly that it can do neither, but then there is the danger in a short time, as the tree grows, of the bandage becoming so tight as to stop the circulation of sap and injure or even kill the tree. My own method where an ornamental box is built round a tree, has been, inside the box near the top, to put a board across with a hole in the centre larger than the trunk. The inside of this should be protected, or rather bound, that it may not cut the bark, and for this purpose I have found by far the best material to be old pieces of rubber hose tacked to the top of the board, passed through the opening and the tacked again below. Then, as the tree enlarges, draw the two parts of your board farther open and nail them afresh. Of course the board must be in two parts or you could not have got it there.

Let me say a word as to the reason why, especially if the situation be at all exposed, the tree principally needs staking. Say the young tree has been lately planted and has much of a head, which, by the way, it should not have. When the leaves come out the wind will have power upon it. It will then, if not staked, waver in the earth, and this wavering will not be confined to the mere surface of the earth, but will penetrate deeply, shake the roots in the soil and more or less delay the progress of their growth. For the field, of course, less expensive methods of staking than that described above are used. The following article from Mr. Webster, of Wales, describes the method used there, a place where they need them. Coming along the sea-coast there every tree seems to lean:—

Next to careful planting and watering, a matter of the most vital importance but unfortunately one that is too often lost sight of, is the efficient staking or otherwise securing of large transplanted trees. The great strain and consequent damage to the roots of large transplants when allowed to rock about with every gust of wind, is not only highly injurious, but in viewing the matter from the point of neatness, few things in forestry have a more unsightly or neglected appearance than trees almost blown over by the wind.

Various are the methods usually adopted in staking or tying newly transplanted trees which, as no hard and fast lines can be laid down, as a rule, must to a great extent depend on the size of the plant as well as situation and exposure. Thus a tree four feet, six feet, or even eight feet in height may, in a low-lying sheltered situation be perfectly safe, without stake or tie of any kind, whereas another of a similar size growing in an open situation and exposed to the prevailing winds of the district, will require a mooring of the most secure description, and adjusted in the most efficient manner.

For trees and shrubs up to six feet in height, a strong sharp-pointed stake should be driven firmly into the ground within six inches of the main stem and on the most exposed side. The stake may be from four feet to five feet in length and should never be driven perpendicularly but with the top slightly inclined from the tree and in the direction from which the prevailing winds blow.

stout ligature of some kind, such as tarred rope or thick bass matting, is then passed around the stem of the tree requiring support, at from three to four feet from the ground and made fast to the stake at a similar height. By crossing the tie between the tree and stake a more efficient job is performed, as there is then less room for the tree to work in when rocking with the wind. It will thus be seen that the nearer the stem of the tree the stake is placed, the greater the power of resistance will be. Some may object to this method on the ground that driving a stake so close to the stem must injure the roots, but this is an error, as when the stake is well pointed and carefully driven the damage is inconsiderable, and will be found so by trying the experiment. The above method has been in force here for many years, and I need hardly add has been productive of the most satisfactory results.

When the trees or shrubs are over six feet in height and of a bushy nature, stronger moorings than that just described will have to be resorted to, and the following plan we have found suitable for almost any emergency:—A strong band of leather or several plies of tarred rope is placed loosely around the stem of the tree to be staked, and at say three-quarters its height. Some wires (ordinary fencing wire) are then joined to this collar, two on the most exposed side and one on the other, and made fast to stout stakes driven firmly in the ground at a distance from the main stem proportionate to the tree's height.

A. D. WEBSTER.

BIRDS AS DESTROYERS OF INSECTS.

Much has been said against the English sparrow, and I have no doubt he does annoy some horticulturists and pomologists. I am, myself, inclined to think, however, that they have done a much more good than harm. Every spring, indeed, they eat off the tops of my lettuce, but they meddle with no other vegetables, and I easily save even these with a piece of light gauze. As for insects, I have watched one sparrow in an afternoon buzzing along the cracks of my big painted fence and pulling out a dozen spiders successively. Every one remembers the amount of filth the cobwebs used to make—their network crossed every doorway—but they are no trouble now. Then, too, were these measuring worms, they were here by millions, you could not go under a tree but half-a-dozen would try to lower themselves on to you, while they used a swarm over the currant and gooseberry trees. We seldom see one since the sparrows' advent.

But it is not only the sparrow. Our fields and woods were once populated with beautiful little birds, many of them gay of plumage and pleasant of voice. They sat on the rail fences as you walked along, and sung to you from every tree. These birds had certainly not been used to live on grain and fruit, for they had been native in the land long before any one grew either the one or the other. Why could we not have left them alone? The farmer does not think when he sends his boy for the old musket to shoot a few little birds which might possibly in the year do him twenty cents' worth of damage that he is teaching

the boy a lesson of selfish greediness which shall induce him to leave the old farm and the old man to their own devices, as soon as he can make five dollars more thereby.

I have never been more disgusted than by seeing the young men of two districts engaging in what they call a shooting match. Each party, during the day, doing their best to destroy the harmless, feathered denizens of the wilderness, till at night every feather counts, and the party who has done most injury to the neighbourhood has won the prize. You can see the game—a heap of little dead birds last morning, beautiful and bright, the chief pleasure of wood and meadow to every sympathetic mind. They are now a bloody and useless heap. But for such selfish tyranny, providence has appointed its unerring punishments.

The following is from Marsh—"Man and Nature":—

"An unfortunate and popular error," says Marsh, "greatly magnifies the injury done to the crops of grain and leguminous vegetables by wild birds. Very many of those generally supposed to consume large quantities of the seed of cultivated plants, really feed almost exclusively upon insects, and frequent the wheat fields, not for the sake of the grain, but for the eggs, larvæ and fly of the multiplied tribes of insect life, which are so destructive to the harvests. This fact has been so well established by the examination of the stomachs of great numbers of birds in Europe and New England, at different seasons of the year that it is no longer open to doubt, and it appears highly probable that even the species which consume more or less grain, generally make amends by destroying insects whose ravages would have been still more injurious. On this subject we have much more evidence besides that derived from dissection. Direct observation has shown, in many instances, that the destruction of wild birds has been followed by a great multiplication of noxious insects, and, on the other hand, that these latter have been much reduced in numbers by the protection and increase of the birds that devour them. Many interesting facts of this nature have been collected by professed naturalists, but I shall content myself with a few taken from familiar and generally accessible sources."

The following extract is from Michelet, *L'Oïsean*, pp. 169, 170:—"The stingy farmer—an epithet justly and feelingly bestowed by Virgil. Avaricious blind, indeed, who proscribes the birds—those destroyers of insects, those defenders of his harvests. Not a grain for the creature which, during the rain of winter, hunts the future insect, finds out the nests of the larvæ, examines turns over every leaf, and destroys every day thousands of incipient caterpillars. But sacks of corn for the mature insect, whole fields for the grasshopper, which the birds would have made war upon. With eyes fixed upon his furrow, upon the present moment only, without seeing and without foreseeing, blind to the great harmony which is never broken with impunity, he has everywhere demanded or approved laws for the extermination of that necessary ally of his toil—the insectivorous bird. And the insect has well avenged the bird. It has become necessary to revoke, in haste, the proscription. In the Isle of Bourbon for instance, a price was set on the head of the martin; it disappeared and the grasshopper took possession of the island, devouring, withering, scorching with a biting drought, all that they did not consume. In North America it has been the same with the starling, the protector of Indian corn. Even the sparrow which really does attack grain, but which protects it still more, the pilferer, the outlaw loaded with abuse and smitten with curses; it has been found in Hungary that they were likely to perish without him; that he alone could sustain the mighty war against the beetles, and the thousand winged enemies that

swarm in the lowlands. They have revoked the decree of banishment, recalled in haste this valiant militia, which, though deficient in discipline, is, nevertheless, the salvation of the country."

"Not long since, in the neighbourhood of Rouen and in the valley of Moulville, the blackbird was for some time proscribed. The beetles profited well by this proscription; their larvæ, infinitely multiplied, carried on their subterranean labours with such success, that a meadow was shown me, the surface of which was completely dried up, every herbaceous root was consumed, and the whole grassy mantle, easily loosened, might have been rolled up and carried away like a carpet."

TREE SHELTER FOR FARMS.

An English opinion, stated in "Woods and Forests," says: "I quite agree with your remarks last week on this subject. A narrow strip of wood left on the crest of the hills, and on the north and west lines of many farms, would pay a large interest by the increase of the crops which would result from such shelter on the remainder of the farm. Where the woods have been cut away, I think it would pay well to plant these strips, and by good care, to promote their growth as rapidly as possible. Quick-growing species in this case should be selected, such as chestnuts, maples and poplars. I have, for several years, allowed all young trees growing along the fences, to grow. I have trimmed them, and quite a number of them have grown so rapidly, that I have trees which will soon be good to cut for rails, posts or wood. They take no room, shelter the field, and give some shade for cattle."

This opinion is now becoming prevalent in Ontario. In travelling through the country of late years, I find everywhere lines of trees being planted along the road-sides and the dividing fences of farms. So far as this can do it within the next twenty years, we shall see much of Ontario sheltered by lines of trees, and those who have neglected it until then, noticing the undoubted benefits, will be busy planting and regretting the time they have allowed to elapse before doing so. In planting trees along roads, however, it is the opinion of many that they should be confined to the north side, in order that having the south sun they may dry the sooner after rain. Some indeed object to trees along the road or fences either, and would have nothing but wire, to avoid the possibility of snow drifting into the road. It must be remembered, however, that where wind-breaks are frequent over the surface of the country, the winds will be greatly checked. It should be remembered also that the shade of the trees in summer is very pleasant while travelling on the roads. Again, the soil is a question of consideration. I remember when my road to market laid through seventeen miles of second growth trees on either side, not tall, but tall enough to thoroughly shade the roads. The shade, however, never seemed to make the roads bad. It was a sandy, gravelly soil, and soon dried up. But the day of dependence on mud roads in Ontario ought soon to pass by. There is plenty of stone and gravel in the country to make good roads, (and once well made they last a long time). I know places in England where the paved stone roads, made by the

Second Roman legion two thousand years ago, have been used ever since, and some of them are good roads still. But there is another thing to be remembered concerning these roads. They pass through a deep forest, which catches and holds the rain. Had they been in the open ground they would have been torn up by floods long ago. Farmers, again, are apt to call themselves too poor to make good roads. In America we are too apt to think that land will last for ever without manuring. The first thing is to get the field rich; the next thing is to prevent the rich land from washing away. Nothing will do this but shelter. It is asked: Why do not the prairie lands lose their fertility? They do lose it. When forty years ago I passed through Illinois and Iowa, everybody thought they would get a hundred bushels an acre of corn. I passed the same fields a year or two since, and they were not getting half that amount. Much of their soil had gone into the Mississippi. They have had plenty of time since to shelter their fields well, but instead, they have made little more than a commencement.

THE FUNCTIONS OF TREE LEAVES.

An English writer gives the following idea, which will be found to have some connection with the foregoing paragraph:—

“The leaves of trees seem destined by nature, to perform two essential functions; first, strong to inhale during hot and dry weather, moisture from the atmosphere during the night, in order to repair the waste occasioned by the perspiration of the preceding day; and secondly, to receive the juices propelled to them from the root, and, as secreting organs, to prepare and elaborate the sap so received, to fit it for the support and enlargement of all the woody parts of the plant. Hence every branch, according to its size, after appropriating to its own use what is necessary, sends down the residue to the stem and roots for their enlargement, as well as for the multiplication of the roots, which may be proved from the roots of every tree being in the ratio of its branches. Thus every part of the plant acts and re-acts; the branches are augmented by the roots, and the roots by the branches. Pontey, a high authority in arboriculture, and others, consider that the principal use of the leaves is to attract the sap upwards, and that tapering stems are occasioned by branches obstructing the ascent of the sap, and also applying it to their own use, thus preventing the enlargement of the stem upwards; so that, according to their ideas, if the lower branches are removed, a greater portion of sap will go to the enlargement of the stem above.”

Whoever reads the foregoing paragraph carefully, will understand why rows of trees, though valuable for shelter, never can produce timber. They branch out, as is their nature, and each branch, as is well explained above, prevents the stem from growing so large above itself as it would otherwise do. For this reason, where trees are set closely in plantations, which prevents the growth of the lower branches, the trees acquire a tall, straight stem, clear of knots and

making good timber. It becomes, in fact, altogether a different tree. In the open field, by itself, a maple tree will run to about fifty feet in height. It will be thick set, with branches almost from the ground to the summit, and they will spread forty feet. If you come to cut it down you will find very little timber in the tree beside branchwood, which does, indeed, make good fuel. The same tree in a forest or plantation would be without branches, from forty to sixty feet from the ground, after which it would have a spreading head above, and the trunk should yield clear timber all the way to the branches. Granting that the two trees had been planted fifty years, the second should be two feet or more through at its base.

THE BLACK WALNUT.

Many enquiries are made yearly concerning the methods of growing the black walnut, and also as to whether it will flourish in the northern parts of Ontario. The black walnut was, in its native forests, seldom seen much north of the Grand Trunk line. Many, however, have planted it north of that—I have known it to do well near Collingwood. The question, however, can only be solved by the establishment of a plantation—isolated trees give no data whatever. I should not, however, recommend expensive experiments being made with it far north of its old position. In the southern part of Ontario it grows well, but I know of no large plantations. In the States, where the climate was pretty nearly that of our own Welland, I have seen many thousand trees set in plantations ten feet apart. These had grown in forty years to trees over eighty feet in height, thirty inches through at the base and fifty feet up to the branches. They would not make good furniture timber, I was informed, for twenty years more, when it was expected they would realize very large sums. The walnuts should be piled in sand or in litter all winter where they will freeze. By planting time in the spring many will have sprouted, which should be planted in one place and those which have not in another. We have many trees in Canada, however, such as the cherry and the ash, which will stand a northern climate much better and grow to valuable timber in half the time.

The following pieces on black walnut from "Woods and Forests," are valuable :—

Having cultivated this tree in Austria, and also witnessed its growth from the present time backwards for sixty years, my mite of information in reference to it may be of some use to such of your readers interested in forest planting. Our stock was raised annually from seed collected from the older trees. They begin to bear in their tenth year. The seed was thrown into a heap to rot the outer fleshy envelope; it was then put into a cellar during October, and placed in layers in moderately dry white sand; but the sand is immaterial, earth answers the same purpose equally well.

In spring, when good planting weather sets in, the seeds were carefully gone over; those that had sprouted were planted in nursery lines, nine inches apart in beds conveniently broad for cleaning purposes, and the unsprouted ones were planted the same distances apart later. In view of frosty nights it was thought advisable to protect the tender plumules with a little dry litter, but the unsprouted ones did not need this protection. The growth the first year would average over 1½ feet in good ground. Early in the following spring the young plants were carefully dug out and planted at distances of two feet between the rows and one foot apart in the rows; after that biennial removals were sufficient till they were large enough to plant out permanently.

In the case of forest planting we found it to be best to allow the peasants to take over a piece of land intended for a plantation rent free, and cultivate it for two years with maize, gourds, sugar beets or potatoes. This was generally dug with the spade, and kept very clean, thereby bringing the soil into good tilth for the trees intended to be planted. The seed was then put in as before, but at four feet intervals. In average ground, kept clean for the first two years, the trees attained a height of ten feet in five years, and during that time received one pruning off of the lower laterals. With judicious thinning out as time went on the trees grew quickly, and have straight stems which do not branch out into a head much under twenty feet from the ground.

I found that they did well on land flooded annually from a neighboring stream during the months of May and June. They grew equally well on unflooded land, but not in that which was sandy, very dry, or poor in quality. Some of the best timber grew in swampy river deposit with standing water just about three feet under the surface. I may add that the seed should be obtained during the autumn.

Now that the subject of profitable tree planting is creating a good deal of attention in this country, the remarks in "Woods and Forests" respecting the merits of the black walnut will be read with interest by those who are on the look-out for information with regard to the most profitable trees to plant. The following extract from the *Chicago Times* shows conclusively the demand, value, and scarcity of this tree in the States:—

Black walnut has disappeared in two-thirds of the States of the Union in which it was once plentiful. First, Ohio and Indiana were stripped, then Kentucky and Tennessee. The enormous advance in the price of this wood during the past three years attests its scarcity, while parties of men who are going through the States whose trees are gone, pulling up stumps to be used for veneers, show how difficult it has proved to be to find a substitute for this wood, with its even grain, dark finish, and freedom from warping. Cherry stained black has been tried, but no stain lasts, and it is worth noticing that Bouille, the greatest master of cabinet-work that ever lived, utterly refused to work in cherry, and preferred to deal patiently but for all time with the great difficulties of ebony. Until the young walnut groves, which are being planted in all directions, begin to furnish a supply, however, some substitute must be found."

Americans are evidently alive to the want, and have already set to work to plant the tree extensively with a view to meet the continuous and increasing demand, and doubtless at the same time with the idea of a good investment, with a quick and profitable return for capital laid out in planting. It appears that no other timber has been found as yet to be a substitute for the walnut. The above I think is strong evidence that the black walnut ought to be planted in this country freely as a tree for future commerce.

BLACK BIRCH.

"The black birch, which is rapidly coming in favour, is a close-grained and very handsome wood, and can be easily stained to resemble walnut exactly. It is just as easy to work, and is suitable for nearly, if not all, the purposes to which black walnut is at present applied. Birch is much the same color as cherry, but the latter wood is now scarce, and consequently dear. It is difficult to obtain cherry at fifty dollars a thousand feet, while birch can be had at any saw-mill at very much less indeed. When properly stained, it is almost impossible to distinguish the difference between it and walnut, as it is susceptible of a beautiful polish, equal to any wood now used in the manufacture of furniture. There is a great difference in the wood of different sections. Where the land is high and dry, the wood is firm and clear, but if the land is low and wet the wood has a tendency to be soft and of a bluish colour. In all the northern regions it can be found in great abundance, and as the tree grows to such a great size, little trouble is experienced in procuring it in large quantities.

The foregoing, from a Toronto paper, is correct in most particulars. Birch, however, as I have seen it in many a northern forest, is in no such abundance as the woods to which in other days we used to apply that term. The woods yet remaining to the north are not such as we destroyed to make our Ontario farms. For instance, I have seen many a maple forest—many a long stretch where nothing grew but beech, but I never found a forest of birch. In the northern regions, say near the Magnetawan, or in the Nipissing Territory, you will every here and there meet with an immense birch tree—nothing like the small spreading birch trees we see in streets or parks, but three feet or more through the trunk, and rising to a great height. Much might be culled from these forests and should be, as it is mature. One common use to which it is put, which meets every-one's eye, is our perforated chair seats. These are not of one but of three thicknesses, the centre one laid crossways of the grain.

TREES AND RAIN.

"Woods and Forests" gives a short but valuable article on trees and rain:—

"In Italy the clearing of the Apennines is believed to have seriously altered the climate of the Po valley; and now the African sirocco, never known to the armies of ancient Rome, breathes its hot blighting breath over the right bank of the river in the territory of Parma. The similar removal of the pine forests near Ravenna, about twenty miles long, induced the same desolate wind, which continued until the wood had been allowed to grow again. There is no doubt that in France, the removal of the old forests of the Vosges sensibly deteriorated the climate on the plains of Alsace; and it is a historic fact that the ancient destruction of the forests of Cervennes under the reign of Augustus, left the large and rich tracts near the mouth of the Rhone, exposed to the steady violence of the mistral (or north-west wind) before which the area of olive culture has retreated many leagues; the orange is confined to a few sheltered points on the coast, and fruit trees can hardly be reared in places where they were at one time prolific.

The curtailment of the rainfall is a well known consequence of the disappearance of forests. In Egypt, where, during the French occupation, in 1798, not a drop of rain fell for sixteen months, and where from time immemorial, the country has been a rainless bed of sand, Mohamed Ali, by planting his millions of fig and orange trees, has seen his country blessed, with an annual rainfall of several inches."

FORESTRY IN AMERICA.

"It costs a very great sum of money," says an American paper, "to plant and cultivate even a thousand acres of white pine trees, yet a thousand acres of white pine, if planted this year, could not, at the end of half a century, keep a single second or third class mill in Michigan running half a year, so enormous is the consumption of timber in this country. If the native forests, which are sure to disappear shortly unless a different policy is pursued, are to be replaced by forests reared by human hands, vast capital and enormous energy must be expended in the undertaking, our great supply of timber must be drawn from the native forests as long as any native forests remain upon any part of this continent. Hence it is the native forests which demand the attention of legislators and the public. They should be protected to the utmost from destruction by fire; they should be made by law as secure a property to hold as the nature of such property will allow. Great fortunes have been made by holding forest property, and still greater ones are to be made if the danger from fire and the burdens of taxation can be reduced within reasonable limits. Some of the state legislators are already looking after these two things."

What the United States must now look to are the pine trees of the Southern States, and the Redwood, as it is called, of the Pacific slopes. The great forests of the Eastern and Middle States are so largely used up that many wood working industries, some of which were thought to be secure in a supply of timber for centuries, are proposing to leave them for the South or West.

NEGLECTING YOUNG TREES.

"I have lately, writes a gentleman in *Wood and Forest*, been looking over some old bills which I have had from various nurserymen, and am astonished to find the quantities of pines and other specimen trees which I have had from them during these last dozen years; and where are they now? Some few have been destroyed by ground game; but the main quantity having been guarded, where lost, have been choked by the grass and branches. You come upon a suitable place for a specimen and get a pine or a Wellingtonia, as the case may be, out of your little nursery, which no estate should be without, and think to yourself, 'Now, I'll look after this tree and see that it gets fair play.' A couple of years pass and accidentally you tread the same path. Your memory is jogged by seeing either a brown, dead stem, or a poor creature struggling for its life in the midst of a mass of brambles, growing all the more luxuriantly for the stirring of the ground. I intend, in future, to keep a book, enter all specimen trees in it, marked when and where planted, and have them looked to twice a summer."

On all our country roads, and on many a farm, we see young trees to which this will apply. They are not here, however, so likely to be choked with weeds; it is the burning sun and the dry weather which destroy our planted out trees by tens of thousands. Mulching them when planted with straw or litter, held in place by stones, if necessary, or stirring the earth around the tree as wide as the branches, twice in the summer, would save them all.

VALUE OF MOUNTAIN FORESTS.

The following article from the report of J. B. Harrison, Esq., Commissioner of Forests for New Hampshire, applies with much force to some parts of Ontario where we have many mountainous districts of land, as well as many flat districts, or both intermixed, which should be preserved, partly that they are at the head waters of streams, partly that they are mostly of land which, after a few years' cropping, will give little value to the farmer. I have previously endeavored to state most of the ideas given below to my readers, but some years ago, and in this differing style they may be more effective:—

The first and most important function of mountain forests is the preservation of the mountains themselves by clothing them with soil. The relation of mountain forests to the soil out of which they grow is curious and interesting. The soil now produces the trees, but the forest has produced the soil which now nourishes it. There was a time when there was no soil on the mountains of New Hampshire, nor on any portion of the Appalachian system—when the mountains were only ridges, slopes, and summits of bare rock. They were composed wholly of mineral substances, of matter entirely inert and incapable of supplying food to vegetable organisms. There was not an atom of soil on the rocks of the whole region, and no vegetable growth of any kind. Then, when conditions permitted, nature began a new order of things here with some of the lowest forms of vegetable life resembling the lichens of our time. Some of these could grow here and there on the rocks, and whatever could grow would die and decay, but would not wholly perish. Some slight particles of its fibre or substance would remain undestroyed through all the changes of decomposition, and in the course of centuries or thousands of years, a thin film of soil was accumulated here and there, sufficient to nourish vegetation of a little higher character and organization than had belonged to the pioneer organisms.

How great the distance from that far beginning to the first tree! And very poor and inferior trees the earliest ones were when they did appear, compared with those which make our forests now; but they were the best that the still scanty soil would sustain. Ever since the leaves of the first trees began to fall the trees have been slowly adding to the deposit of soil which now covers the rocks, and which has reached the depth and productive potency required to sustain the noble forests of our own time.

The great stratum of fertile, life-producing soil which now lies folded around the shoulders of the hills is the result and accumulation of patient ages of dendral toil. Nature has wrought incessantly, through mighty cycles of time, to clothe the desert rocks with life and beauty, and in the untainted air of these lofty slopes and plateaus she now grows forests which are like the columned

aisles of vast cathedrals. Ships which cleave the waves of every sea; and the cottages and palaces of mighty cities, with myriads of structures for man's varied industries, have been builded of materials supplied by our mountain forests. The superior quality of the timber now grown, and the vast quantities in which it is produced, are effects of the wonderful fertility which the soil has attained. It is richer than ever before, but it has not reached the limit of possible productiveness. There is no such limit, indeed, and if our mountain forests were rightly managed they would forever increase in fertility, and the quality of their timber would be thereby gradually improved.

A forest is the only crop, so far as I know, which can be produced perpetually on the same ground without diminishing in any degree the fertility of the soil. It is a remarkable fact that a forest not only does not impoverish the soil out of which it grows, but that it actually enriches it. As the soil is thus improved it responds by producing superior timber. A mountain forest would yield better timber, and more of it, at the end of a thousand years of proper management than at the beginning, and proper management means and includes the cutting of every tree when it reaches its best estate.

FARMING IN MOUNTAIN REGIONS.

The entire effort at farming in mountain forest-regions in this country is often a most destructive and suicidal mistake. Much of the ground that has been cleared for cultivation in such regions is so steep that if forest-conditions are once destroyed upon it the soil is certain to be washed away. It has always been manifest to intelligent observers that such land is suited to the perpetual production of timber, and of that crop alone. In many instances in our state land has been cleared and "farmed" with very slight returns, which would be much more valuable than it now is if it were still clothed with forest. The yield of farm product in such cases is scanty and uncertain. In some places the land is too high and cold for successful cultivation. There are frosts late in spring and early in autumn, and sometimes in every month of the brief summer, and the soil is soon exhausted. It would be difficult to find anywhere an instance of more obvious natural adaption to the particular function than our whole mountain forest-region exhibits in its fitness for permanent forest-growth and its unfitness for any permanent beneficial use after forest-conditions have been fully destroyed. It would have been much better if some of our "abandoned farms" had never been cleared. In some parts of our country vast values have been permanently blotted out by clearing and cultivating mountain land, and those States will be poorer for all time to come by reason of the resulting destruction and removal of the soil of considerable areas of their mountain regions.

RUIN BY FIRE.

The most fatal agency in destroying the soil of a mountain forest-country, and in wrecking the mountains themselves, is that of fire, and in the history of most mountain forest-regions the operation of this agency has been closely connected with the attempts to cultivate the soil to which I have just referred. In various regions of the Appalachian mountain system many of the farms have been cleared simply by burning the timber and brush left on a tract after it has been lumbered over, and the first crop is planted in the ashes. In a few years the soil is exhausted or washed away, and the farmer goes a little further up or down the valley, or across the stream which runs through it, and repeats the

operation. But the injury to the mountains which is caused by the destruction of the soil of these limited tracts which have been cleared for cultivation is trivial when compared with the losses which have resulted from the forest-fires having their origin in these clearings.

When we consider the rapidly increasing density of the population of our country, and the great advance in the value of all fertile lands, especially in the Eastern States, it is obvious that the complete destruction of the soil of any considerable area is a very serious matter. There are few kinds of losses or misfortunes affecting property which are so calamitous as this. It is a crime against posterity, a permanent subtraction from the wealth and the capabilities of the country. The soil is, to a very great extent, the country itself. A burned city can be rebuilt, and the system of insurance distributes the loss widely. But there is no insurance on the soil of our mountain forests, and when it is once thoroughly burned it will require mighty cycles of time to restore it. Its producing capacity for ages, and all the "promise and potency" of a perpetual succession of valuable crops, are at once reduced to nothingness.—*From the Report of J. B. Harrison, Commissioner of Forests for New Hampshire.*

FORESTS IN THEIR RELATION TO THE PUBLIC HEALTH.*

BY DR. BRYCE, TORONTO, SECRETARY ONTARIO BOARD OF HEALTH.

Mr. President, Ladies and Gentlemen of the Association:—From the earliest times that the phenomena of climate have been observed, we have abundant evidence that the presence or absence of forests has been remarked as producing influences, which have had their effects upon the salubrity of different localities; and, in the warmer countries of Southern Europe and Asia, the deities of the woods and groves stood in high favor with their devoted worshippers.

The people of more recent centuries, too, have not been blind to the protective influence of forests; but it has, until very recent years, been difficult for the energetic settlers who have had to hew out for themselves homes from the forest primeval, to view the sturdy forest trees in any other light than that of their natural enemies.

Indeed, it yet seems hard for us, as we visit our frontier settlements and see the small clearances and limited sources of income which the settler possesses, not to sympathise with him in his struggle for existence, and to view with calm indifference the wanton destruction of the woods, which, in older settled portions of the continent, are coming to be looked upon with a regard akin to reverence. To most of us the value of our forests, as direct revenue producers, must naturally appeal first, while to many others their indirect value from the influence they exert on agricultural productiveness will appear important; but few, indeed, have carefully considered how far-reaching are the influences which their existence or their non-existence may exert upon the public health. Some few months ago I had the honor to briefly introduce the subject of "The Preservation of our Forests a National Sanitary Need" to the International Conference of State Boards of Health then in session at Nashville, Tenn., at a time when the levees of the Mississippi were in danger, and when in some of the Gulf States, destruction had visited extensive areas of country. The Conference, and notably those delegates from the South-Western States, realizing the importance of the matter, adopted strong resolutions expressing their views, and forwarded them to Federal and State authorities, urging the adoption of

* Read at the meeting of the American Forestry Association, Quebec, 1890.

such legislation as would encourage tree-planting in suitable localities over the continent, and thereby serve to mitigate in some degree that destruction of life and property from floods and cyclones, due in large measure, we believe, to the absence of adequate forests on the head waters of many of our largest rivers, and upon the thousands of miles of prairies popularly spoken of as treeless.

To further show its active interest in the important work of which this Congress is the exponent, the Conference, through its president, has requested me to attend here as its delegate, and lend to those who are engaged in this praiseworthy work the support of our Association, whose members comprise the most active and prominent sanitarians of the various states and provinces on the continent. In the name, therefore, of the International Conference of State Boards, I am present to-day to offer this assembled Congress greeting, and to offer the active support of this conference of health officers in all measures tending to the abatement, or, at least, the mitigation of those evils which are unfortunately too apparent to all of us.

Engaged some fourteen years ago in lecturing on chemistry and meteorology to the students of the Agricultural College of Ontario, I became greatly interested in the influence on organic vegetable life, of the amounts of rainfall during the months of germination and growth; and being anxious to determine, if possible, the truth of the theoretical teachings of chemical physics, as regards the relationships between soils, trees, and the circumambient atmosphere, I made a careful and laborious study of the tables of the Toronto observatory, beginning with 1840, and for purposes of comparison took the semi-decades of 1840-45, 1850-55, 1860-65, 1870-75.

From the tables which were published at the time in a paper read before the Canadian Institute, several results became apparent.

TOTAL SNOW AND RAIN.

1840-44.....	216.57	inches.
1850-54.....	164.684	"
1860-64.....	160.387	"
1870-74.....	152.62	"

or, between the first and fourth periods there was a total decrease of 63.95 inches, or a yearly difference of 12.79 inches.

The total moisture is divided as follows:

TOTAL RAIN FALL.

1840-44.....	191.020	inches
1850-54.....	137.999	"
1860-64.....	131.706	"
1870-74.....	113.150	"

or, between the first and fourth periods there was a total decrease of 77.87 inches, or a yearly difference of 15.35 inches.

TOTAL SNOW FALL (12 inches snow, one inch rain.)

1840-44.....	322.70	inches
1850-54.....	320.10	"
1860-64.....	344.38	"
1870-74.....	473.83	"

or, between the first and fourth periods there was a total difference of 151.13 inches, or a yearly increase of 12.59 inches.

These calculations agree exactly with theory. In comparing the individual quarters of each period, I arrived at the following results:—March has remained much the same still; with April is found a decrease of more than $\frac{1}{2}$ inch, a decrease that increases with each month until September, thus:—

	April, May, June,	July, August, September.
1840-44.....	48.55	68.101
1850-54.....	40.195	48.625
1860-64.....	32.742	45.617
1870-74.....	34.670	35.14

The significance of this unpleasant change must be evident to all. The average temperature of the two months of germination is lower now than it was forty years ago. Thus:—

	March.	April.	May.
1840-44.....	29.88	42.62	51.22
1850-54.....	30.24	40.06	50.68
1860-64.....	29.02	40.80	52.86
1870-74.....	27.24	40.18	53.36

This undoubted fact causes what is termed a late spring, the period for growth and development of the plant being shorter than formerly. The temperature of May, the first month of real growth, is now warmer than formerly, by an average of nearly two degrees. The growth is thus apparently forced unnaturally to make up for loss in April, but the attempt is rendered futile by an undue dryness, the rainfall in May having been:—

1840-44.....	15.015 inches.
1850-54.....	13.675 “
1860-64.....	14.055 “
1870-74.....	8.640 “

I do not propose to again discuss these figures, further than to say that it is apparent that if the period of germination is made later in Ontario by April becoming colder, and if the month of May, is notably hotter and drier, then that normal development of plants is very materially affected, and results in greatly reduced arboricultural returns. It will further be manifest, however, that those causes, whether of damp soil, cold winds or excessive heat, which are inimical to normal or healthy plant growth, may become the conditions favoring the operation of other influences inimical to plant life, such as vegetable parasites, the poisonous effects of the complex organic products of an aerobic bacterial life in imperfectly aerated soils, of insects, etc., etc. I cannot forbear illustrating this point by referring to a recent paper by Prof. H. Marshall Ward in the proceedings of the Royal Society, “On Some Relations between Host and Parasite in certain Epidemic Diseases of Plants.”

He points out what would seem self-evident, “that a plant may vary within very wide limits of the condition we term health.” We may, for instance, having a herbaceous plant growing under a high July temperature with an abundance of solar light, when suddenly the temperature falls, rain sets in and

the weather remains cloudy for days. Transpiration through the leaves being almost stopped the plant becomes suffused with water and the movements of the absorbed gases are greatly retarded. Now to realize the effects, we have to recognise that the growth of the plant depends upon a healthy condition of its sap, which contains corpuscles and nutritive fluids, which constitute its circulatory system just as much, and in the same sense, as the blood does in an animal. Prof. Ward further points out that the life and growth of the plant depend upon the absorption and assimilation of food, commonly spoken of as metabolism. What thus goes on in the plant depends upon the fact that the cell protoplasm absorbs oxygen brought to it from the water of the soil and from the air, and this oxygen combines with the various compounds contained in the protoplasm. These bodies are thus broken up while others form new unions. Complicated life movements are thus set up, and heat even is developed by the oxygen taking hold of the carbo-hydrates, as starch and glucose, and by the nitrogen absorbed, certain nitrogenous compounds often called, in medicine, the active principles of a plant, as asparagin, etc., are found. A most interesting fact which finds its parallel in the excessive development of acid compounds in the blood of rheumatics and persons suffering from various other troubles, is found in the excessive formation, out of protoplasm, etc., when a lack of carbohydrates occurs in the plants, tissues and sap, of organic acids (such as malic, oxalic, etc.) They are due to incomplete oxidation and their variations in quantity depend greatly on the activity of the metabolic processes and, therefore, on the intensity of respiration.

Remembering that the carbohydrates are formed by carbon dioxide and water meeting in the chlorophyll of the leaves and other growing tissues, and that the activity of the chemical changes depends largely upon certain rays of sunlight, we can in some degree comprehend how the conditions, favorable to vigorous plant life, must in a very special sense be the measure of the resistance which any plant will make to injurious influences. Here, again, we find a parallelism to the resistance which the animal organism offers to malign influences. Housed in dark work-rooms and offices with limited supplies of fresh air or oxygen, we have as a result imperfect assimilation or metabolism going on in the blood and tissues, and so we find that the germs of disease in the shape of vegetable parasites, as diphtheria, obtain an easy victory over debilitated and non-oxidized tissues.

Prof. Ward details at some length how the fungus *Botrytis* develops on many plants, and points out that sunshine is wholly unnecessary to its development, and that dull, damp weather and a saturated atmosphere, so injurious to higher vegetation if prolonged and at a low temperature, are distinctly favorable to the development of these fungi. It has been found further, that the mycelium of the fungus develops a ferment—just, for instance, as the diphtheritic microbe secretes a *leucomaine*, which acts as a poison to the human system—and that the poison possesses the property of swelling and dissolving cellulose, and further seems to kill the protoplasm at the points where the fungus has made its way into the cell-tissues of the plant. The action seems to be associated with the formation by the fungus of oxalic acid, which in excess rapidly destroys protoplasm, and so acting like other acids, causes the leaves of the plant to turn brown. The result is analogous to the effects seen, notably upon evergreens in the neighbourhood of brickyards, where, during the burning, sulphurous products are given off, which being oxidized in the atmosphere, exert an acid action on the soft tissues of the growing wood.

Hence we see that whatever makes for normal growth and development in plants tends equally to enable them to resist the attacks of malign influences.

We find further admirable examples of this in the wheat-rust, the potato blight, black-knot, etc., and in the conditions opposing or favoring their development.

We now naturally must turn and inquire whether we have any analogous conditions which affect climate unfavorably as regards the health of man, and if so, whether the same laws with regard to increased liability to disease become operative. Let us examine these physical influences and effects, which all will agree are largely the result of deforesting. We are accustomed to the use of the terms, (a) *equable, limited* or *insular*, as applied to climates with slight yearly and diurnal variations; and (b) to *extreme, excessive* or *continental*, i. e., as applied to climates with great variations. As producing these we speak of proximity to extensive water surfaces, height above sea-level, etc. In addition to these classes and others, such as latitude, nature of the soil, etc., we recognise that the covering of the soil plays an important function. Herbage, as remarked by the latter Dr. Parkes, is always healthy, but trees play by far the most important part of any kind of vegetation: (a) By keeping the ground cool through directly obstructing the sun's rays: (b) By presenting in their leaves an immense evaporating surface: (c) By this means taking up through the roots an enormous amount of water, thereby preventing a stagnation of ground water, and aiding healthy nitrification processes by the constant introduction of oxygen into the soil: (d) By thereby creating a moist and cool atmosphere around the tree through evaporation, while the same process prevents rapid chilling of the soil by radiation, and at the same time, by the circulation of the sap, a rapid chilling of the tender, exposed parts of the tree is obviated.

We thus have, through the beneficent agency of trees, an equability of climate, obtained in no other way, and in so far as this is a factor favorable to health, we have a distinct advantage to be gained by the preservation of trees.

On the other side, where forests are absent, the excessively rapid changes in temperature, induced by rapid radiation of the earth's heat, affect most unfavourably those exposed to this rapid chilling, and who may not have such strength and vigor of constitution, as to resist its effects. The rapid abstraction of body heat is as inimical to the health of man as of plants, and leaves persons exposed to specific causes, which, under more favorable conditions, are inoperative. Associate with these extreme daily-ranges of temperature, frequent extremes of weather, as of winds and storms, and we have exactly those physical conditions productive of internal congestions, inducing in some form or other, those diseases which hold so prominent a place in our mortality tables. Take but one disease, the causation of which has been long in dispute. Surgeon Major Oldham, of the Indian Medical Service, insists that malaria is due to cold. Logan, in a work on the climate of Chili, tells us that malaria prevails on the table lands, while the lower levels are free from it.

So much then on this part of the influence of trees in preventing a rapid and extreme chilling of the soil and of the atmosphere contiguous to it.

Speaking in the more exact language of to-day, I would say that these gentlemen ascribe to the moisture and cold a condition whereby a cause is given an opportunity of becoming operative by their depressing influences. In other words, the monad, the cause of malaria having entered the system becomes capable under these conditions, of multiplying and overcoming the resistance of the body, just as *Botrytis*, under similar conditions, grows in plants.

Their influence in preventing these rapid and extreme changes, applies likewise in the matter of forests lessening the changeability and violence of the wind.

Dr. Charles Smart, Acting Surgeon General United States army, made some careful experiments on the laws regulating radiation of heat, and other relations thereto of wind and moisture. He says there are three principal factors going to make

up climate in its relations to our animal heat, viz.: (1) The absolute temperature of the air: (2) Its motion: (3) The moisture contained in it. The effects of rapid radiation upon the human system, it is assumed by a large school of etiologists, are so great as to produce disorganisation of the nervous mechanism that presides over the temperature of the body, and this upsetting of the heat regulating centre is likely to happen when the body has been subjected, during the day, to extreme solar heats and fatigue, and is exposed after sundown, and in the night to the tropical or sub-tropical chill, which will be severe in proportion to the rapid cooling of the ground, and the amount of vapor condensed in the lower stratum of air.

How notable are the differences in the degrees of radiation of heat from the earth is seen in the statement made by Tyndall in connection with some radiation experiments published in detail several years ago, to the effect that were it not for this invisible gaseous envelope, with its moisture surrounding the earth, it would long ago have radiated its heat to an extent totally destructive to the life of every living organism. All of us are familiar with the old example of how on the desert plains, whose soil may attain a temperature of 150° or more during the day, radiation produces, after sundown, so rapid a cooling as to produce hoar-frost as seen on the blankets of travellers who have laid down to sleep on the sands in the open air.

In the matter of clothing our bodies we find the same laws in operation, and protect ourselves by non-conducting flannel and silk under garments.

It is well to recall what long ago was affirmed, that plagues were stopped in their progression by forests, while there is indubitable evidence going to show that belts of trees have effectually protected communities against the emanations of malarious marshes.

I now propose to speak of an influence exerted by forests, which, studied to some extent, has from the very nature of the case, been but imperfectly appreciated. I refer to their influence, first upon ground waters, and second, as related thereto, their influences upon the processes of nitrification.

Our literature teems, with illustrations of how the never-ceasing and uniform flow of springs celebrated for their curative properties, and presided over by some old-time deity, has been largely decreased by the wanton destruction of the forests which protected their sources; while in Ontario we behold the yearly decreasing volume of the dozen or more splendid rivers, which taking their rise in the central plateau, flow toward some one of the four great lakes, Ontario, Erie, Huron or Georgian Bay.

Towns and cities have sprung up on every side, and as their needs have increased they have looked for local sources of public water supplies, only to find their local streams uncertain in amount during the later summer months, while their decreased volume has resulted in a relatively increased pollution, which makes their use as a source of public water supply, in many instances, quite out of the question. All will see how serious such a matter becomes in its relations to health. But this evil is much more far-reaching in its effects. Assuming that under ordinary circumstances the amount of water which finds its way into the soil is 50% of the total annual rainfall, it will be apparent that if in all parts of the Province, the snows, by the irregularities of the winter season, pass away rapidly, as they now frequently do during a thaw, to the streams and rivers without being taken-up by the then frozen ground; if further during the spring the heat of the sun causes so rapid a melting of the snow, as to make bare the fields in a few days, and fill the streams to overflowing, there results an incalculable loss to the underground sources of supply, which we are coming to look upon more and more as reservoirs, never-failing in their abundance and

perfect purity. What such losses mean may perhaps be appreciated when I say that, assuming that six inches of the 25 or 30 inches of annual rainfall are lost by deforesting, we have a direct loss to our underground sources of supply amounting to nearly 100,000,000 gallons per square mile of surface. What this loss means to a city which has to look to driven-wells for its supply will readily be understood, since the more extended that the necessary gathering ground becomes the more expensive does the matter become to the city, whose demands are constantly increasing. Curious as it may appear we see on every side two constantly attendant phenomena, yearly and increasing needs of pure and sufficient water for our cities, and yearly decreasing supplies as regards both purity and quantity. Remembering that it is commonly agreed that more than eighty per cent. of all our typhoid fever is produced through the medium of drinking water; that some 700 deaths and more than 10,000 cases occur in Ontario yearly, causing a loss of labor, of more than 300,000 days, and at least as much more unproductive expenditure of capital, we can understand how from the health standpoint alone deforesting has an economic importance, well-worthy of our most serious consideration. The matter of the loss to the soil produced by the sudden disappearance of the water resulting from the melting snows, and the equally useless and even destructive effects of the torrents which are poured upon the baked and arid surfaces of our fields, by the thunder storms of summer, have another and far-reaching influence in the matter of the retention and utilization of the organic matters of the soil. The vegetable organic matters of our virgin soils, the manures which are deposited on our agricultural lands, depend alike for their beneficial effects, upon whether they are quickly utilized by being converted through the action of the bacteria of the soil into compounds assimilable by plants. Now, upon the aeration and upon the moisture of the soil will depend the rapidity and perfection of the nitrification process. All are aware of how manured or meadow lands often seem to be productive of but little results during a dry summer, and again of how a soil cold and unaerated is equally barren of results. We recognise the reasons of this as two-fold; first, a lack of drainage, whereby the water of the subsoil is prevented from being removed in such a manner as to allow of *aeration* of the soil, and second, from a lack of warmth of soil whereby the bacteria are able to multiply rapidly. A soil left dry after the floods bakes and becomes impervious to air; while its cold subsoil may be so clogged with water, that the bacterial action which goes on is productive only of those compounds which produced by microbes multiplying in the absence of oxygen, are positively injurious to plant-life. Now, when we refer to the effects of forests upon the soil we find that, while they enable the water entangled in the interstices of the leaf-mould and humus, to pass silently into the earth, protected against the scorching rays of the sun, they likewise act in the most positive manner as drains to large areas of surrounding soil. Their tap-roots running downward often pierce retentive clays, and the organic decomposition which goes on in the root fibres creates innumerable drains by means of which subsoil waters are lowered to a notable degree. How great this drainage becomes may be measured by the amount of water which is evaporated by a tree. Parkes and others have given us figures showing an evaporation from the leaves of a tree as equal to $2\frac{1}{2}$ gallons daily, or as given by another equalling 212 inches of an annual rainfall. This evaporation may be best comprehended by imagining it to be at least equal to one foot of water from a surface equal to fifteen feet square.

This removal of ground water, viewed from the public health standpoint, is most important. By drainage or a lowering of the ground water, Dr. Buchanan, president of the Local Government Board of England, has shown that in a few

years, the death-rate from consumption in drained towns was reduced nearly 50%; while everyone is familiar with the story of how, at a Trappist monastery situated on the Roman Campagna, eucalyptus trees planted about it caused a disappearance of malaria from all the inmates except from amongst those whose rooms looked upon a damp inner court. This phenomenon being observed, several eucalyptus trees were planted in the court, when through the drying of the soil by their roots, and a utilizing of the products of normal decomposition of the soil, those conditions favorable to the development of the malarial poison in the soil were removed and the disease disappeared.

This phase of the subject is worthy of much more extended treatment, but time prevents us.

Regarding those direct influences upon the public health, resulting from floods and cyclones, I shall not speak at length. They are patent to all. If there ever were a year when our legislators, our scientists, the people generally have been made aware of how nature, "*red in tooth and claw*," avenges herself on those who despise her teachings, it is the year of grace 1890. I had intended to have made a table showing the disasters from these causes, as collated from the reports of the daily press, but I have forborne. It would have recalled horrors useful only so far as they teach us lessons. Modern science is striving with much success to chain every force of nature to the car of human progress, but it would seem as if the father of the gods resents the violation of nature's laws and this destruction of her sylvan fanes, while the stealing of the fire of the gods by a modern Prometheus results as of old only in the punishment of man. *Sic itur ad astra* seems ever to have as its refrain *facile est descensus Averno*, and to balance the evil and good between these, the lumberman and agriculturist who would subdue the earth, and those, as the sanitarian, the engineer and poet who would maintain inviolate nature's gifts in the trees, is equally the aim and we trust the attainable ideal of such Congresses as this.

"We trust that somehow good will be the final goal of ill."

FORESTRY CORRESPONDENCE.

The following letters and extracts give an idea of the progress of forestry throughout Ontario, and also much valuable experience of the various writers. They were mostly in reply to the following list of questions:—

1. Whether and to what extent lines of trees for windbreak or ornament are being planted, and how those planted are thriving?
2. Whether plantations of young trees have been set out, and how they succeed?
3. Whether cattle are fenced out from any portions of forest in your neighborhood, and how it answers?
4. Any difference in climate, rainfall, drifting of snow, and so forth, you may have observed since the clearing of the country?
5. What measures, if any, would be likely to improve the existing state of affairs?

1. A good many, in this neighborhood, are planting trees for wind-breaks and also for ornament. The kinds of trees principally used being Norway spruce, soft maple and our native red cedar. The last named makes an excellent wind-break, as they grow very close; in this respect they are equal, if not better than the Norway spruce, and are much cheaper. I have wind-breaks on the north

and west of my building and orchard, those on the north being principally soft maple; but, on the west, which is exposed to the severe blasts off Lake Erie, a double row of soft maple, Norway spruce and red cedar. The maples and cedars I get on my own farm, and the Norway spruce from the nursery at Kingsville, only a few miles away. They are all doing very well.

2. I know of only one plantation, that of Hiram Walker & Sons, which was planted last spring at their far-famed summer resort (the Metawas), near the village of Kingsville, on Lake Erie shore; they planted 1,000 trees, principally soft maples and elms, and as far as I can ascertain, they are doing very well.

3. I am sorry to say that cattle are not fenced out of any portion of forest in this neighborhood. I am satisfied it would be a great benefit to the little forest that is left, if cattle were fenced out. I notice that where they are allowed to run in bush pastures, everything in the shape of second growth is completely destroyed, and nothing allowed to grow but the larger timber, which, in a few years, will be all gone.

4. I am told, by old settlers here, that the climate has changed very much since this township was first settled. In those days they knew nothing of the long drouths that we have now nearly every year. What little snow we get is very little benefit to us, as it is all piled up along the fences. Consequently, our wheat fields are left bare and exposed to the hard freezing weather that we generally have in January and February.

5. I have no doubt that tree-planting, especially in belts along northern and western exposures, would be a great improvement.—JAMES H. BROWN, Harrow, Essex Co.

1. A few lines of trees have been planted along roadsides and are doing well. 2. None set out in plantations. 3. Cattle are generally fenced out, and it is a great advantage to the young trees. 4. The snow drifts badly, blocking the roads and leaving the fields almost bare. 5. A compulsory Arbor Day would fill the bill, so far as roadside planting is concerned, each path-master overseeing the work the same as ordinary road work.—JOSEPH GRIFFIN, Crewe, Huron Co.

1. Norway spruce make the best wind-break. There have been four lines of them planted in this section; they grow very well, a little slow at first. 2. We have seen no regular plantations of young trees, but I think young forest trees would succeed well if that the field mice could be prevented from girdling them when young. 3. Cattle are fenced out from some portions of forest. I fenced cattle out from fifteen acres of hardwood bush for about five years and the bush began to grow very thick with little maples, ironwoods, and white ash. 4. No difference except heavier snow drifts in winter resulting from want of protection.—WILLIAM CURRY, Hills Green, Huron Co.

1. I have been planting trees for wind-breaks and find them beneficial—spruce, balsam and others. 2. The trees succeed well. 3. Cattle are not fenced out in Algoma, except in rare cases. N.B.—I lived in Huron County for twenty-five years and found out the benefit of trees around farm-yards and orchards.—WILLIAM HARRIS, Day Mills, Algoma.

1. This section of Western Ontario was more lately settled than most of the surrounding counties, and, therefore, the value of the forests has not been felt until lately. The timber was very fine, consisting chiefly of maple, beech, elm, ash, basswood, oak, birch, and black cherry, in deciduous trees, and hemlock, balsam, and arbor vitæ in evergreens. A large part—too much, indeed—of these woods has been cut down or destroyed by fire. Until lately very few trees were planted on farms in this neighborhood, but now numbers are planted every spring along the roadsides and around the orchards, barns and houses. The

greatest difficulty with most persons seems to be that a large number of the trees fail to grow. The soil is a heavy clay, and newly set trees do not appear to grow so readily as on a lighter soil. I have known men who planted trees and, at least, three-fourths of them did not grow, but it was chiefly through their own carelessness in not taking care of the trees, as others get nearly all to grow. 2. No plantations have been set out as yet. 3. The larger number of farmers allow their cattle, sheep, etc., to run in the woods, but those who "fence them out" soon have a dense undergrowth of young trees and berry bushes growing up, and all are agreed that it is the best plan. In this, however, it is as with planted trees, viz.:—they do better on a lighter soil. 4. Since removing the forests, the winds are stronger, thus causing damage to grain, fences, etc., and also the storms are much more severe in winter. The snow is blown off the fields and laid in great drifts in the hollows and by the fence sides. The drought of summer has also been increased. 5. Many farmers are rather ignorant on this subject and to enlighten them as to the advantages of planting trees, and the necessity for caring for what they do plant would, I think, improve the state of affairs.—JAMES NEILSON, Newton, Perth Co.

Some few years since you gave me good advice which was acted on with happy results, but in consequence of most of my young trees being Norway spruce, and very palatable to most farm animals, I could, with hopes of good success, only plant where stock could be kept out of the fields, so planted, altogether, or else go to much expense and trouble in fencing around the trees. However, had I gone to the trouble and expense, to a much greater extent at the time, even had I borrowed the money for the purpose, I should feel better satisfied now. I have about three or four thousand planted out in single, double and treble rows, in places where they are of much benefit to both stock and crops, besides beautifying the farm, most of them having been planted out about twelve years, and these are about fifteen feet high, much admired by any one with any taste for things of beauty, and they are a great prevention against snow drifting of the adjoining roads. 1. There has not been much done by the rank and file of the farmers in the way of tree-planting, but by amateur farmers, such as those who have made money by professions, lumbering, etc., much more progress in that line has been made, and the trees mostly planted have been hard maples (*acer saccharinum*) which are the kings of deciduous trees for street or roadside planting, and some soft maples and elms. 2. Very little has been done in this way except by myself, and the success attending what I have done is beyond my most sanguine expectations, particularly where the land had been properly prepared by good tillage, and where grass and weeds were kept down, and potatoes or other root or hoed crops were planted between rows for five or six years, or until the trees nearly covered the ground and were making good headway. 3. In very few places, but in these few, the benefit is very apparent in the preservation of the forest. 4. Cannot say that the rainfall has been lessened, as the season just passed has been the wettest I have ever noticed, but there has been a marked falling off of the streams and rivers going on for years and still going on. The weather, however, seems to be more changeable, caused, no doubt, by the removal of forests which acted as wind-breaks and barriers in reducing the velocity of the winds and modifying the temperature. The snow drifts, of course, now exist in a most obstructive manner where formerly they were unknown. 5. My idea would be to instruct through the newspapers. 1st. As to the best varieties of trees to plant. It always makes me unhappy to see as I do, in nine cases out of ten, people plant as evergreens "balsams" (*Abies Balsamea*), almost worthless trees, where they could almost as easily have procured "black" or "double spruce" (*Abies Nigra*), a splendid hardy native tree, and when well

grown, superior, in my opinion, to the best grown specimens of the Norway spruce (*Abies Excelsa*), although of admitted slower growth than the latter, they are closer, more robust, and spread out better. I know where there are two or three specimens of them worth driving ten miles to see—about thirty feet high and with a spread of twenty-five feet. It is equally upsetting to me to see a preference shown to the soft maple (*Acer rubrum*) for street and roadside planting, and having it advocated as a more suitable tree than the hard maple (*Acer saccharinum*). The Norway maple (*Acer platanoides*) is a fine and hardy tree and thrives well in this section of the country.—EDWARD D. NEWTON, M.D., Barrie, Simcoe Co.

1. Trees planted along roadsides more or less every spring, but not to any great extent—seem to be thriving. 2. No, no attention paid to it. 3. The woodlands from which cattle are excluded full of young vigorous growth—none where they run. 4. A great difference in my recollection of fifty-six years—drying up of springs, impassable drifted roads. 5. Government aid to stimulate planting. A general Arbor Day same as for schools. Nurseries of trees furnished at cost by government. New varieties such as larch, Norway spruce, sweet chestnut, etc. Trees furnished to those who send an order. Blank orders sent to any address.—JOHN LE BOUTILLIER, Glen Miller, Hastings Co.

1. In this section, people seem very reluctant in undertaking setting out lines of trees for shelter, several have set out trees for ornament with good success. 2. Question—No, none. But they would be a success if properly attended to. 3. I know of only one or two who shut their cattle out of their woods. In these cases there are lots of young trees from two inches to twelve feet in height, making a thick growth that will in a few years make quite a forest of beech, maple and other hardwood. 4. For some reason the summer is cooler. Rain falls heavier, apparently. Snow drifts are more frequent and heavier since the timber has been cut away. 5. I should say addresses or papers on the subject, read at Farmer's Institutes by some one in a position to answer all questions there at the same time, would have a good effect.—JESSE H. KILLMAN, North Pelham, Monck.

Until the age of twenty-three, my home was in Switzerland, and there, wherever the forest is cut down for any purpose whatever, it is always replanted the next year. 1. In our neighbourhood very few trees have been planted, either for ornament or wind-breaks, but wherever planted, they are thriving well. 2. None whatever. 3. Cattle are not fenced out in any case that I know. The cattle in a forest are a great draw back to its growth, as they browse the young trees. 4. Much colder, and cold weather is much keener. I am sure that the forests temper the cold; much more drifting when the snow falls. For some years back, we have not had the necessary summer rain, but could not attribute it to the clearing of the forest, though I think that forests draw and keep moisture. 5. To introduce the most valuable forest trees, at the cheapest rate, to parties interested and willing to plant, in different localities through the country; my experience is, that groves of forest through the country would be very beneficial to serial culture.—FREDERICK ALLEMAND, Eden, Elgin Co.

Planted 250 trees along the highway—maple and some ash,—mostly growing well. Almost all the farmers are planting lines of maples along the roads in the older settled parts of our townships. Evergreens make the best wind-break in the winter. Keeping cattle out of the bush would be a great saving to the young trees, but they would have to be thinned out.—SAMUEL KERR, Rockwood, Wellington Co.

1. A few lines of trees have been set out and are thriving very well. 2. I

am not aware of any. 3. Not all the year, for a portion while the crop is growing and harvesting. 4. It appears colder in winter. The snow does not lie on the fall wheat, as formerly. The clover catch is more uncertain. 5. A bonus of a certain amount per acre, when five or ten years growing. One-half paid by the Provincial Government, the other half to be paid by the municipality in which the plantation is situated, and the municipality should have no option, but should be made compulsory as grants to High Schools.

Our forests are being cut down unusually fast these years, for several reasons I shall name. 1. The times are bad for farmers, and those having mortgages or legacies to pay have recourse to the few remaining acres of bush, to help them out of their difficulty. 2. A person purchases a farm with five or ten acres of good bush upon it; he calculates to sell the wood as soon as possible, to assist him in paying for his farm. 3. A well-to-do farmer intends retiring from the business, and is going to sell his farm, before doing so he makes an auction sale of the standing timber, realizing by this mode of selling, more for his property. 4. A farmer has several sons, he cannot buy farms for all, the homestead is too small to divide between them, the timber is first cut and sold, then the farm is sold and many of them go to the North-West. 5. Farmers who have tried it, say that coal is much cheaper for fuel, so the wood is sold, the interest of which provides coal sufficient for them; then they have the use of the land as clear profit. Unless some measures are taken towards encouraging planting out plantations, York Co. will be worse than the western prairie, through the foregoing reasons; for we will not have the rich soil of the west to plant our plantations, and consequently the growth will be slow.—D. JAMES, Thornhill, York Co.

1. In my neighbourhood, trees (principally maple) are planted along farms bordering on the highway, as ornaments only, and in most cases, very poorly done. But the taste for planting is growing and spreading, and young trees are easily obtained. 2. There are no wind-breaks that I know of, except what were reserved at the back of farms for fuel. 3. It seems that the farmers delight to turn their young cattle into the woods during the summer to forage for their *existence* and to the detriment of the very young second growth. 4. The want of more bush certainly causes the snow to drift more than it did before the great clearing, and roads boarded by rail fences are often impassable every winter. 5. People must be taught. Arbor day in Public Schools is a good thing, but a great number of our teachers don't know anything about a tree.

Some years ago, I read a report of yours on forestry with a great deal of interest, and it set me a thinking and talking to my neighbours, and I also planted, and intend to plant more, year after year. More resinous trees are wanted to border our roads; they are the proper ones for that purpose, while those wanted for timber or fuel should be planted in blocks.—C. H. PETERSON, Clifford, Wellington Co.

1. Quite a number of forest trees planted in this section, but they do not succeed well, either from careless planting or too dry summers. The kinds are principally sugar and soft maple. But so far as my observation and experience go, I would advise for forest trees, soft elm, oak, walnut, butternut, sweet chestnut, and box elder, a rapid growing tree, and surpassing the maple for sugar. This tree is pretty scarce and hard to get, but if any person would like to get this kind of tree, which I highly recommend on the account of its hardness and rapid growth, I will try to get it for them. 2. I have seen no plantations in this part. 3. Cattle are not fenced out of any portion of forest. 4. No material differences in rain, or climate or drifting of snow. 5. Cultivate the

minds of the people, and impress the importance of planting forest trees, such as above mentioned, and evergreens around orchards and buildings.—T. RICKARD, Alvinston, Lambton Co.

In some cases cattle are fenced out of pieces of bushland. I myself fenced off about twelve acres of bush, from which nearly all the larger timber had been cut, the surface of the ground becoming sodded with June grass, and what small timber was left was getting stunted or was dying. It is some six years since it was fenced. For the first three years there was no marked change, but since, raspberry canes sprang up and amongst them countless little seedlings, mostly maples. These little trees are doing nicely now, and I hope to live to see a fine young sugar-bush from them. The forest here is growing less every year, yet the rainfall for the last two summers was excessive. So much rain fell that a great deal of the crop, growing on low or level land was drowned repeatedly, and even high land became sour.—JOHN McARTON, Carleton Place, Lanark Co.

1. No lines or clumps of timber planted for windbreaks; some little is being done for ornamentation, but not extensively. 2. No. 3. No. 4. Yes, for correct statement of the difference see meteorological reports from Beatrice and Gravenhurst, at the Meteorological Office, Toronto. 5. Our elevated and rocky land is being denuded of its timber. With us many people seem to depend more on what they can take out of the bush, than what they can get out of the clearing to eke out a livelihood, and are stripping the forest of all it contains of any marketable value, without considering for a moment the price they are paying for the crust they get, and are only deferring for a short period the time when they must pull up stakes and quit, or pay more attention to the more legitimate calling of the farm.—JOHN HOLLINGWORTH, Beatrice, Muskoka.

1. There have been very few trees of any sort planted out, but what few there are do well and grow very rapidly. 2. No, the forest supply is large enough to supply the demand for ten or twelve years yet. 3. There are but two farmers fence out cattle from the wood, which are growing up with berry bushes. 4. Yes, there is a big difference. The wind gets more of a sweep. There seems to be more thunder storms, and the rains are not so equally divided, causing drouth. The snow does not come so early, but drifts more, and not so deep in the fields. 5. If there were more trees set along the roads and along certain fences over the farms, I believe they would draw more moisture and improve the farms, and they would be a benefit when the forests get a little scarce. I believe it is the farmers' duty to look after the forests for their own interests.—NICHOLAS DE HART, Creighton, Simcoe.

1. Nearly all new surveys of lots in or near the city have been planted with trees along the streets for ornament, principally hard maple. Our own firm have planted over two hundred trees in this way within the last three years, most of which are doing well. 4. Our winters seem shorter and more broken, the difference in the temperature of day and night seems greater; where exposed the snow drifts from the fields to the fences; streams rise quicker after storms and go dry sooner than when more forest existed. 5. Better education of farmers to the value of forests in nature. Instruction in rural schools and a more general observing of arbor day.—H. S. MOORE, Hamilton.

2. Three years ago I planted out seed including catalpa, butternut, black walnut, and American sweet chestnut—I since put in maple and yellow locust. The whole grew amazingly, and when a year old, I transplanted them and now have trees from six to nine feet high. My experience would lead me to recommend my brother farmers to start forest plantations at once. I might add that

I consider your forestry report a grand publication. My knowledge of tree-planting has been largely acquired by reading the reports.—CHRYSTAL GOSSEL, Kincardine, Bruce.

1. A small per cent. of the farmers have been setting maples for ornament. 3. There is but one bush in my neighborhood where cattle are excluded that I know of, and that is my own. 5. I would advise all persons having woodland to keep stock from running in to them, Lastly, would advise all persons to set out plantations and also trees for ornament.—WILLIAM NEICE, Stromness, Monck.

1. I am strongly in favor of tree planting. Since this section of country has been denuded of timber our winter roads are nearly impassable; the winds sweep the fields bare of snow and pile it up on the roads. We often have to drive in the fields which makes travelling very disagreeable. Our meadows are often badly winter-killed for want of a covering of snow. My neighbor, on the east side of my farm, has a nice sugar bush of twenty-five acres, which affords considerable shelter to my fields opposite. 2. Our first snow storm last winter came on the 27th and 28th November, from the east with a very strong wind which swept the fields bare where there was no shelter, but opposite the bush mentioned the fields were covered with snow, to the great benefit of the clover in my new meadow. Where the snow lay there was a fine crop of clover and timothy this season. The rest of the meadow was winter-killed, no clover remaining and timothy injured. Concerning orchards, I find that shelter is very beneficial. Thirty-five years ago I planted my first apple trees. The winter after was very severe. My trees all died except a few that were planted near the fences and were covered in the snow drifts; these trees still remain vigorous, while I have had to renew the middle of the field with apple trees several times since. We have done considerable tree planting the last thirty years, which has improved the appearance of my farm very much and makes considerable shelter. We have a row of sugar maples on each side of the highway, across my farm, also other trees planted around orchards and gardens. We find that evergreen trees make a good windbreak. On the north side of orchards and farm yards we need shelter very much in this cold climate. We find that where fields are sheltered by woods the frost does not penetrate so deep in winter, therefore the soil dries much earlier in spring and is ready for cultivation much sooner than fields that are not sheltered.—WILLIAM CROSS, Caledonia Springs, Prescott Co.

1. A large number of trees are planted for ornament, few for windbreaks. 2. But one plantation in this section—that is sugar maple, and is doing well. 3. No, very few but they should be. 4. Yes, I fancy we have more sudden changes than formerly, also longer and more severe droughts, it also affects our streams very much—sudden floods and very low water. The wind certainly has far more sweep than formerly to drift snow. 5. I think evergreen trees should be planted along the roadsides. Something must be done, and done soon, to keep up our supply of timber. There is a great deal of waste land that is now almost worthless that could be made very profitable by planting to trees.—R. DAWSON, Mohawk, Brant Co.

1. A few of the better farms have single rows of trees along the roads and fences. 5. More and better planting and better care when planted.—A. H. GOING, Tilsonburg, Norfolk Co.

As I am an ardent supporter of tree planting and forestry, I beg leave to reply I am constantly travelling through the County of Norfolk. The original forests are fast disappearing, and no effort has been made to replace them. There was a splendid forest all through here of pine, oak, elm, chestnut, walnut, beech, maple, etc., but it is largely gone now. All kinds of trees grow well here, and if

the farmers could only be got to take an interest, even if the mere seed were sown and cattle kept out, the woods would soon be crowded with fine young trees.—J. S. HODGINS, Simcoe, Norfolk Co.

Within the past ten years I have set out some four or five hundred trees, principally maples, with a few Lombardy poplars, horsechestnuts and Russian mulberries. My opinion is that tree planting should be encouraged by every means possible, as they are not only ornamental and beautiful shades, but serve chiefly as a great check upon the bleak and drying winds that sweep across the country deterring and often destroying rapid and healthy vegetation. The total deforesting of a country exposes it to the action of wind and heat, encouraging droughts and the drying up of springs and streams that give moisture to the immediate vicinity surrounding them.—WILSON ARNOLD, Trenton, Hastings Co.

Tree planting would be of great benefit to orchards and fields, as the country in this part is so cleared up that even the fall wheat suffers to a great extent from having no shelter. I would recommend a double row of trees along the dividing lines of every farm, and also on the sides of orchards.—ROBERT GIRVIN, Thornyhurst, Bothwell.

Since the forest has been cleared between me and the lake and the country is exposed to the full sweep of the wind from the lake; the snow drifts in great piles around fences and sweeps the fields bare, making it almost impossible to raise any fall wheat, except around the fences where the snow lies. I honestly believe if forest trees were planted in abundance it would remedy this, and we would be able to grow larger crops of fall wheat, and be able to drive along the roads in winter.—THOMAS SALLOW, Goderich, Huron Co.

In Georgina, Thorah and Brock many farmers have planted out lines of trees. Maples prosper; of 250 I saw set out only four died. The higher ground is exposed. I have often seen fall wheat come through winter in good shape but the cold winds of March and April would kill it. I know only of one man who preserved a real wind break—a second growth of maples which he had fenced off—some forty feet. This gentleman, Mr. Keenan, now of Orillia, told me that he never had one crop to fail him during some thirty years. Cattle are permitted to roam everywhere in the forest. The drifting of snow is much greater than formerly. Creeks and wells dry up in summer that did not do so before. As to the remedy, that seems difficult. The people do not understand the matter, and it must be impressed upon their minds; first upon the old, then upon the young. To reach the old a prize might be given by the county or township for the best artificially protected farm. The young should be imbued with ideas of forestry in the schools.—FRANCIS F. ROHLER, Vroomanton, Ontario Co.

Much valuable timber destroyed in our township, but none that could be helped for several years back. Wood will scarce last fifteen years; many have none. 1. Not one in a hundred have a good wind-break, but handsome rows of maples are growing up. 2. No plantations. 3. Cattle not fenced out. 4. Snow-drifts bad. 5. After a few years when wood becomes more valuable the farmers will see it to be to their interest to keep cattle out of their woods, and will put out plantations of young trees on rough pieces of ground. Wood has been of no value in the past, and men have been doing all they could to get rid of it; so that you and all the men in Canada may write and talk to no purpose until wood gets scarce and more valuable, then there will be a rush all at once on how to secure a supply of wood. I am of opinion that when men see those beautiful rows of maples grow up in front of farms, and how it beautifies and makes the farm more valuable, that one after the other will follow suit until all, or nearly all, will have them planted out.—ANDREW MCGILL, Chatsworth, Grey Co.

Notice a cleared valley ; in the spring the side hills will often be bare of grass or wheat, or whatever might have been there. The current of air has been too strong. Plant trees across alternately so as to turn the current and the air will be checked, and those side hills bear the best fruit. Plant chestnut, both for posts and rails, for the nuts and for honey. Basswood is excellent, too, for bees and for lumber. The elm, too, is good here. But also plant cedar and spruce, for these trees drive away insects, especially from orchards, banishing the curculio from plums and cherries. Alternately, too, in an orchard these resinous trees are good for the same purpose. People should plant more of these trees and less of maple, for there is no tree grows which reduces the soil as much as maple.—L. KITCHEN, Bloomsburg, Norfolk Co.

1. Very few lines of trees are being planted, also very few of the ornamental. 2. Very few have been (young trees) set out, and what have been are maple. But they do not thrive, as the way people have of planting is not of the best. 3. Cattle are not fenced out from the forest. But they should, and most farmers know that. 4. I do not know of any difference in climate or rainfall, but I do in snow drifts. More dust now, less health, more catarrh, more wind, more dryness more discontent. I would make this recommendation to every farmer. Near his house I would have a square on the north side filled up with all sorts of trees, such as butternut, hickory, walnut, beechnut, hazel, cherry—all wild kinds. Then, again, between the forest trees and house I should have a few flowering trees and shrubs. The whole thing would improve the farm and add beauty to the scene.—M. W. SUMNER, Carleton Place, Lanark Co.

Until the last few years very little tree planting has been done. But now farmers are awakening to see the necessity of planting belts of trees for shelter, to protect their orchards and buildings from the fierce storms which, as the natural forest is being cut down, sweep more frequently through the country ; and already a good beginning has been made in planting shelter belts, chiefly of Norway spruce, and the general feeling is to continue until their orchards and buildings are completely sheltered. Some fourteen years ago, while my neighbours were more or less protected by standing bush, my farm being very much exposed, especially on the north-west side, where for miles the storms had a clear sweep, I planted a double row of evergreens, principally Norway spruce, seventy rods in length on the north and west sides of my orchard and buildings. As I took care to transplant them properly they made a rapid growth, and now, instead of having the coldest place in the neighbourhood, I have the most comfortable, at least so far as storms are concerned. Some of my neighbours who, when I commenced planting, said I was doing a foolish thing, now wish that they had as good a shelter belt as I have. The benefit of shelter to the orchard I find to be very great. Some kinds of fruit and ornamental trees which winter killed while unprotected, now, by being sheltered, come through the winter very well. For instance, I had a number of some fine varieties of plums which winter killed before being protected, but are now doing very well. But the greatest benefits of shelter to orchards, at least in this section of the country, I find to be the protecting the fruit from being blown down by the high winds of late autumn, which generally blows down the largest and best fruit, which is thereby nearly rendered useless. The benefit and comfort of shelter to persons and cattle are very great, in fact it is "better felt than told."—JOHN M. MCAINSH, Belton, Middlesex Co.

1. Many plant trees along the road, and some for wind-breaks round orchards. 2. Not many timber plantations, but very many forest trees. 3. In some woods cattle are kept out, and there the second growth does well. 4. Lines in winter filled with snow. 5. Exemption from taxes for forest preservation.—CHARLES ELLIS, Meaford, Grey.

1. Only along roadsides are trees planted, and that principally for ornament, a great many have been planted in that way, and a few evergreens around buildings. 2. No plantations set out. 3. One or two of the neighbours have excluded cattle, and a nice undergrowth has come up. 4. Since the clearing up of the country I notice the weather is more changeable, the snow drifts more, and we are very much more troubled with floods in time of freshets. 5. I do not think anything can be done to remedy the present state of affairs except something on a very large scale, such as planting with trees the hillsides, especially along rivers and creeks. I would like to see something done to prevent matters from getting worse.—ALEX. FLETCHER, Mount Albert, York.

On lot 5, rear 4th Whitchurch, the owner, Mr. Lloyd, assured me he could always count on fall wheat in certain fields, due to a good sized forest on the north side of the road. I noticed four or five fields of extra good fall wheat last spring west of here, near Richmond Hill station. They were admired by everybody, and the cause was a beautiful strip of pines running north from the side-road on ridge. 5. If ridges like the above could be replanted with evergreens it would effect quite a revolution in the wheat growing of the district, and also in the clover crop.—S. J. WILSON, M.D., Richmond Hill, York.

We think so much of tree planting for shelter, etc., that we have surrounded our farm lands with evergreens and hedge fences, and are planting the same around farm yards and buildings and across the farm for orchard protection. Twenty-five years ago the bleak winds of Lake Erie were held back by our forest, now they sweep across with violence, making its effects felt on man, beast, fences and crops, while all our natural timber forest is gone on our improved lands. We have preserved groves of maple, near which our crops are safe.—E. & S. G. WIGLE, Ruthven, Essex Co.

1. Trees have been planted for ornament quite largely along highways and approaches to residences. Wind-breaks not to any great extent, and are mostly cedar, soft maple, etc. 2. Not enough done to express an intelligent view, but think they would prove a good investment, especially on waste upland. 3. The cattle are allowed in nearly all the woods in this locality, but where fenced out a few years make a vast improvement. Since the woods have been cleared up the snow is in stacks when there is any to drift. In regard to rain, it is at times sent in abundance, while the next season it is a hot, dry time from seed time till harvest. 5. I think if farmers could be induced to plant waste lands to forest and shelter belts we could help the existing state of affairs. There is not a score of farms in this Township but has from two to ten acres unfit to cultivate.—A. S. HODGINS, Osnabruck Centre, Stormont Co.

With the exception of a few trees being planted along the front of their farms by some of our more tasteful farmers, there is nothing done to increase the acreage of timber land. The original forest is fast disappearing, especially in heavy clay soils where the roots do not penetrate deeply and the high winds blow down great quantities annually. I have preserved some fine groves of young timber when clearing, which I value very highly for shade and beauty. I find the hard maple the best tree we have for the purpose of shade and ornament.—H. M. VALENS, Lucknow, Bruce Co.

1. There are few wind-breaks being planted here, but a good many spruce are being planted about the farmers' houses, and deciduous trees on the borders of the roads and in the village streets, all doing well. 2. No, land here is too valuable. 3. No forest here to speak of. Cattle allowed to run. 4. Yes, the creeks and small rivers fill and empty themselves quicker after thaw or rain. 5. Farmers should be induced to plant trees along the fences. The town council

might furnish the trees (deciduous—the conifer are too shady in the spring) if the farmers would plant, and keep them in order.—CHARLES E. TORRANCE, Burlington, Halton Co.

Very little is being done here in the interest of forestry. The forests are fast disappearing, and indeed there is not much use in trying to save the heavy timber, for the high winds of late years blow it down. There are some lines of trees being planted for ornament, none for wind-break to my knowledge. No plantations of forest trees except those planted in rows along fences or on the roadside. I do not know of any bush where cattle are fenced out to save the young trees. Of course there are some sugar bushes nicely kept. Since the country has been cleared, the winds are very much higher, drifting the snow, blocking the roads, breaking down fences and even buildings at times. If the children in the country schools were taught the principles of forestry, it would through them reach the right persons, and would I think, do good. If some of our politicians would tell the farmers about the influence of the forest upon the climate, and talk less about politics, they would then be doing some good for the country.—J. NEWMAN, Cardinal, Grenville Co.

1. Lines for wind-breaks not planted to any extent, but for shade and ornament quite freely, the maple especially. Where cattle are kept away, they thrive well. Have planted myself a large number of Norway spruce, Scotch fir and larch. The firs have done well, the larch not so well. 2. I do not know of any plantations having been set out in this neighborhood. 3. Generally speaking, cattle have not been fenced out of the bush, the consequences being that our woods are rapidly disappearing, and in a few years we will have no bush to fence. The trees are dying faster than we can use them, and in many cases the little piece of bush left is being cut down to save its value in dollars and cents. 4. There is a great difference in the way the rainfall finds its way off the surface. Creeks that once run all the year round, are now dry except for a week or two after heavy rains, when they fill up suddenly, causing floods that are very destructive. 5. Some little thing, however, each one of us might do, we could plant a few hundred evergreens round our houses and barns, which besides adorning our homes and making the landscape a "thing of beauty and joy forever," would naturally add to our comfort, and our children after us would rise up and call us blessed.—JAMES WILLIAMSON, Jarvis, Haldimand Co.

The following letters are from various nursery-men and tree-growers, who were asked to give their opinion on the value of tree shelter:—

As regards tree planting as wind-breaks for orchards, I find that those who have wind-breaks are of the opinion that there is a decided benefit derived therefrom, in preventing the fruit from blowing off, also a protection from the cold in winter. I have noticed fruit trees have a healthier appearance where they are protected by an evergreen belt, than those that are exposed. I am convinced the Norway spruce, ash and Scotch pines, are the best trees for wind-breaks, they grow rapidly, are hardy, live long, bear transplanting well. I would advise planters to plant two or three foot trees twice transplanted, as they will have more success with that size than smaller.—M. MILGAN, Bright, Oxford Co.

I will give you one fact which is worth a host of arguments:

The apple crop is almost a total failure here, but there is one orchard of one hundred and sixty trees, owned by B. Johnston, Esq., of Carleton. The tenant, James Kingdom, has refused \$450 for the year's crop as it hung on the trees. This orchard adjoins the village of Islington, and I can vouch for the facts.

I think it is a mistake to plant shade trees on country roads where the soil is clay, as it prevents the roads from drying, but on sand or along inside fences they would do much good. There is a grove of young pines on the north of

Mr. Johnston's orchard, it covers about half an acre, and protects the trees from the north winds. That is the only reason I can find why this is the only orchard with a crop of fruit on it, in this locality.—J. D. EVANS, Islington, York Co.

There have been many trees planted in this district, many more than have been cared for. Some have the idea, after a tree is planted that is all that is needed, and should make a fine tree without further care, hence so many failures.—A. G. HULL, St. Catharines, Lincoln Co,

The devastation of our forests have rendered it necessary to import European trees, of which I believe the Norway spruce to be the best for shelter, being evergreen. Orchards unsheltered have their fruit blown from the trees untimely, and in time the trees become unfruitful and their growth stunted. I firmly believe the cause of many failures is the planting of trees that are too old. I have planted successfully maple, poplar and spruce.—WM. VAIR, Barrie, Simcoe County.

I think the greatest example of the benefits of protection from heavy winds that I know of, is the notorious fact that along the base of the Niagara escarpment, frost is almost invariably three weeks at least later in doing damage to fruit in the autumn than it is one hundred rods even from the base. It cannot be said therefore that frost is kept off entirely by the wind off the lake, though of course in the winter and spring it is chiefly the proximity of Lake Ontario on the north that makes fruit growing here so successful. In a lesser degree therefore I should say wind-breaks would prevent in a measure the early autumn frosts, provided they are not on the side nearest the water, which is the greatest safeguard at all seasons. It is little use urging the planting of forest trees upon the majority of men until it can be shown to be directly profitable in their own generation, though there may be here and there a man public spirited and far-seeing enough to plant them. In this township of Saltfleet, though a bonus of twenty cents per tree is paid for each tree planted on the roadside, and no cattle or stock of any kind is allowed to run at large unherded, still very few comparatively have planted. I have long urged the importance of the subject. The benefits of wind-breaks on the south and west side of every ten acre field to the crop of winter wheat or clover in causing the snow to lie evenly over the field would soon repay the loss of tillable land. One row of trees would in a few years answer instead of posts, to which wires could be attached for a fence. A row of hard maples would pay well in the crop of delicious syrup and maple sugar which they would produce in twenty years from planting, chestnuts on suitable soil will pay as well as any fruit, and moreover one row might be a row of apple trees. It can easily be demonstrated that a direct source of revenue could be derived from such strips, which I would plant four rods in width, irrespective of the indirect gains previously mentioned.

Every farmer knows that on the lee side of every fence immense snow drifts slowly melting in the spring, often keeps him a week or perhaps two weeks off the land, when the remainder of the field is dry, involving often a crop five or ten bushels per acre less than if sowed earlier. With heavy wind-breaks, the snow would lie evenly over the land and disappear evenly.

It may be urged that tall trees would keep the land shaded and wet on the north side. This could be obviated by planting the very tall growing trees on south side of the belt, gradually decreasing the height, so that the row nearest the north of the belt would be say a row of apple trees, that if it shaded the ground for a short distance would return a profit for a narrow strip left unsown to be cultivated later, as all orchard trees should be, and continuously through the season. A farm surrounded and adorned by rows of evergreens, is a charming sight; some may be seen in Burford township. I am sure such farms would sell

to a man of taste for ten dollars per acre more than one unadorned, though the owner of such a farm seldom needs or wishes to sell.—E. D. SMITH, Winona, Wentworth Co.

I have noticed with the gradual destruction of the forests year by year, a corresponding increase of drouths, and while we may even now have as great a rainfall from year to year as in the days when our forests were in their prime, yet the exposure of such a large proportion of the country's surface to the direct rays of the sun, accompanied by an unobstructed motion of the air, soon absorbs the moisture given by any rain, and in such case of rapid evaporation, the soil becomes hardened and cracks open, making the matter all the worse. Anyone engaged in using or running dry kilns of any kind, whether in making brick, drying lumber or evaporating fruits, will soon learn the necessity of a high temperature with the application of a rapid draft of dry air, in order to rapidly extract the water, and carry off the same. Sturtevant gives the following table as correct, and I have found in my experience in evaporating apples, that he is right in his theory, but the amount of water given is too high. Assuming that 1 cubic foot of air at 32° Fah. or freezing point, will carry $\frac{1}{4}$ of an ounce of water, he claims that with a rise of 27° or at 59° Fah. 1 cubic foot will carry double that or $\frac{1}{2}$ oz., and with every 27° additional in the rise of temperature, the atmosphere will absorb and carry off double the amount of water, therefore with a temperature of 194, being about the average temperature at which evaporators are usually run, each cubic foot will carry 16 ounces of water. Then if the draft of air is by any means increased, the absorption is increased in proportion. Now I have noticed that this is precisely the state of things in reference to the present action of the sun's heat and the unobstructed breezes and high winds, upon the surface of our country as it is now denuded of its forests. The hotter the weather, and the greater the velocity of the wind at the same time, the more rapid will be the absorption of moisture from the soil, and the more severe will be our drouths, and the more destructive will be our rains, accompanied by more frequent winds and cyclones. I believe the most practical outlay in the way of tree-planting, would be in planting wind-breaks of evergreens, and allowing them to grow as tall as possible, thus diminishing the absorbing action of the wind by decreasing its speed, and at the same time beautifying the country and making it more comfortable in winter as well as summer.—JOSEPH TWEDDLE, Stony Creek, Wentworth Co.

Norway spruce and Austrian pine are about the best kind of trees for wind-breaks. We know of some very fine Norway spruce windbreaks around nursery grounds in New York State. The trees are planted close together, almost like in hedge row, and stand now from thirty to forty feet high, making a complete shelter from all heavy winds.—SMITH & VAN DUSER, Winona, Wentworth Co.

It is now very evident that good timber of any kind will soon be very scarce and dear, and unless something is done to prevent deforestation of the country, we will soon be under the expensive necessity of importing lumber. For re-foresting burnt off areas, I believe there is no tree so well adapted as the white pine. The European larch, Scotch pine, and Austrian pine, grow quickly into useful timber, but in that respect they are not at all equal to the white pine. If I were to plant out a forest with a view of obtaining remunerative returns, I would plant it all of white pine. I would plant thickly and thin out as they grew large. For shelter belts I should prefer the Norway spruce, white spruce and Austrian pine.—D. NICOL, Kingston.

In the vicinity of Drummondville, Ont., there have been a great many trees (principally Norway spruce) planted as a protection to orchards and small fruits with much benefit. But would not recommend either too close or too wide a

belt of spruce around an orchard, or *too close to* the orchard, as the breaking off of all the wind tends to increase the codling moth. I would recommend the European larch as the best and most rapid grower of any.—E. MORRIS, Fonthill, Welland.

I would say, if the ground is stiff clay, for young trees I take some coarse sand, and work the sand and soil together and work it around the young roots of the tree; and if you plant one tree with sand and another without sand, you will see that the tree planted with sand will outgrow the other in two years. You will find the same with all kinds of trees and shrubs.—W. M. MORRIS, Seaforth, Huron Co.

We might mention our experience with a small peach orchard. During the past ten years we have had about one hundred trees planted where they are sheltered from the north and west winds by a belt of oak and birch timber. This orchard has repeatedly borne a good crop during seasons when others in the immediate vicinity, but without a shelter, had no fruit whatever.—WEBSTER Bros., Hamilton.

GENERAL CONDITION OF THE NORTH AMERICAN FORESTS.

Translated from the German by H. Von Lorenz

Dr. Mayr, from whose late publication, "The Forests of North America," this article is taken, writes it as an official report for the benefit of Germany. It was written in Japan, where he is now professor of sylviculture, at Tokio. It is very interesting to Canadians, as the view of an educated foreigner. He visited America twice for the purpose:—

When the first Europeans landed on the new continent, they found before them one immense forest.

A vast virgin forest extended at that time from the south point of Florida to the coast of Labrador, through thirty-five degrees of latitude, and from the coast of the Atlantic Ocean to the border of the prairie, that means fully twenty degrees of longitude. If you count the average length of this forest at twenty-five degrees of latitude and the average breadth at twenty degrees of longitude, the forest originally covered the tenfold area of the German Empire; how much of this exists at the present time is hard even to guess.

The non-observant person who travels through North America generally has the impression that the forests are in their original state, that with the exception of a few States forests so prevail that farms only form a small factor of the whole; but the expert would realize immediately that hardly one-third of those woods which his ancestors found 400 years ago now deserves the name of "forest." Two thirds are of later growth, or composed of the remnants of their kind, left only on account of their lack of value. The original virgin forests flourished everywhere, in the mountains as well as in the plains. No rock in the Alleghany Mountains was too steep to prevent single trees from growing in amongst the boulders; the soil of none of the plains was too poor or unproductive, but that large forests would grow in the course of centuries. The swamps alone were the only portions of the country not covered with trees. This fact deserves to be recorded for the information of future generations: for already, in many portions of the country, the forests have been so annihilated that one would scarcely believe that those parts were once covered by magnificent woods.

(The reader will observe that at this point Dr. Mayr indulges in prophesy and takes up the idea which has before been stated on this side the Atlantic, that a large part of the west by planting will ultimately become forested, while the east and southern sea coast, once forested, will fail to preserve any sufficient amount.)

The person travelling through the states surrounding the Gulf of Mexico in fifty years from to-day would not believe that those deserts, covered for miles and miles with snow-white sand, once bore the most magnificent pine trees of the world. In fifty years no man will think it possible that those many bare and sandy rocky slopes of the Alleghanies once were covered with the finest oak, maple, elm and other trees.

In fifty years it will sound almost fabulous that those far-stretching swamps of the southern Wisconsin and Michigan were at one time covered with timbers of the finest varieties and skirted by the finest white pines instead of the poor shrubbery of that day.

Now, let us go farther west and skip again fifty years. What splendid woods will flourish there, owing their existence to the hands of men, on plains once considered deserts incapable of producing anything. People will have planted those woods realizing their great advantages and benefits. Look then at the prosperity of these western settlers who will have propagated new forests in contrast with many of those in the east, who, by fire and axe, transformed their beautiful forests into desolate places and even deserts. The great mistake of the western settlers is likely to consist in mixing too many inferior kinds with the better grades, with the view of producing timber of more use for purposes of fuel than of manufacture. The European woods planted by them will probably not realize their anticipation.

Let us go even farther west. In fifty years it will be almost impossible to comprehend that the beautiful and fertile California, the fruit garden of the Union, once was largely inferior prairie; we could even doubt to be in America, for forests of Australian eucalyptus and acacias grow everywhere; the once hot and barren prairie is transformed in a subtropical garden with all the advantages of this splendid climate.

The doctor then reviews the present:—

Immense sums have been spent in the construction of dams to prevent the streams from the mountains from overflowing the lands during the heavy rains.

Large amounts have also been expended in artificial irrigation after the natural supply of water has ceased from the destruction of the forests in the mountainous districts; the latter has been the case all through the United States. There are some more facts which the observant traveller in America can find every day.

A mountain devoid of trees having on the slopes among the big boulders portions of soil covered with grass and lying on the surface of the rocks, stumps and roots of trees interwoven like a spider's web. What vast quantities of the finest soil are washed down by the rain, owing to the senseless destruction of the forests. One year has destroyed more than centuries can replace. The rain previously partly absorbed by the forests descending in small streams, now rushes down in torrents more annihilating and destroying than fertilizing. Many of the beautiful mountains and valleys of the Alleghanies, Adirondacks, and even the western mountains, will soon be in the same condition. A good many prominent men have already tried to warn and even to interfere, but people declared them dreamers and boasted of the everlasting riches of their forests.

The loudest noise, of course, was made by those who had the largest interest in keeping the nation in blindness concerning the condition of the forests and of their future.

The nation even does not know its own absolute property, many Government and States-lands you find officially described as covered with dense forests; but the truth is, since a long time the best of it is stolen, burnt and the rest left to decay. And to make it worse, fire destroys every year large portions of the younger growth.

The state of New York, to give an instance, according to the report of the forestry commission, Albany, 1885, possesses, or rather claims to possess in the Adirondack 312,400 ha. (the hectare is two and one-half acres) genuine forest. The commission sent out to investigate the condition of these mountain forests could not even fix the boundaries of the State's property, so much of it was claimed by private owners.

In a few districts the State owns widely extended woods, but mostly they are small parcels, hardly ever exceeding 100 ha. Nothing is done by the State of New York to protect and save its forests. (Efforts, however, are being made to save portions of the Adirondacks.) It even does not know their boundaries. Numerous settlers make a fair living by robbing the States forests, and help, by fire and axe, the government to *improve* the woodlands, that is to annihilate forest and forest soil.

Of course, the prospects of the national property are exceedingly dull since the nation does not take care of itself; people often regard and talk about States property as if it had no owner at all, while every citizen is fully entitled to his legal share of it.

You will find in the Union, that when you leave the capital and go west, the ideas about right often decrease in the same way as your distance from said point is increasing.

According to the annual record of the year 1883, the Union Government some times had allowed the poorest settlers and miners in Colorado to take the timber for their domestic use from the government forests. If the law was a liberal one, the interpretation of the settlers was even more so. Government officials, arriving there a few years afterwards, found in the bed of one of the mountain streams half a million of ties, nominally appropriated for domestic use, but really intended for building a railroad.

In Fernow's records I read that the government expends for the protection of the forests annually millions of marks; but what do they amount to if they disappear somewhere without giving the forests the least benefit.

To do credit to the present government we must add, that it has tried to awake public interest concerning government lands and even recovered for the nation 40,000,000 ha. of land illegally held by private individuals and corporations.

In the mountains and in lands where the soil is too poor for continual agricultural purposes, on borders of rivers as long as there is no artificial irrigation, the preservation of the forest is a natural necessity for the protection of the lower lands.

It is not my opinion that the government ought to keep for its own property timber-lands suitable for farming purposes; but it ought to consecrate all its means and powers where the common interest and future is at stake.

In consequence of the immense riches and the great industry of the enterprising people, the government always has a large surplus in the treasury. My opinion is (it may sound ridiculous to the American), the best way to refund part of this money to the nation would be by buying from private individuals

those mountain forests now held by them, and destined to an early annihilation, and to protect them by simple measures, perhaps after the system used in India, against fires, to control them by a government official, and a certain number of constables against thieves, hunters and tourists. The government, and only the government, can afford the monetary loss of interest, but it will be paid ten-fold after the lapse of a few decades.

The consequences of the annihilation of the forests in the mountains are generally known. The best instances may be found in the old world. The illusion that in America everything is different is nonsense. The laws of nature are the same everywhere; the soil may be better here, the climate more favorable for the growth of timber; but the results will be the same; they can be delayed, never changed.

If this mismanagement continues the way it is going on now, it would not take the eye of a prophet to foresee the final condition of many now beautiful and flourishing portions of the country. They will soon, in regard to their barrenness and desolate aspect, rival the southern districts of the Tyrol, South France and Spain.

The government possesses numerous forests in the mountain regions, but it tries to get rid of them as soon as possible and often at miserable prices. The loss of those forests is identical with its ruin. You may say the State helps, while it would be its duty and policy to prevent the shameless destruction of the country, which enriches a few individuals at the cost of the multitude.

Personal liberty and free use of property are the fundamental ideas of the constitution of the union—laws too ideal for a good many of its representatives; to respect the personal freedom of a single individual without conscience, means to trample under foot the personal liberty of thousands better than him.

This ought to justify the claim of the nation that the forests in the mountains, never mind who owns them, must be preserved. To allow hundreds the full free use of their rights and properties, the individual must be restrained. It is more than comical to hear the American talk about the European governments, whose despotism even does not respect private property.

The law in Europe for the protection of forests on mountains, extremely poor lands or borders of rivers is only made for people without knowledge or conscience; nearly all the owners of mountain forests do not need the law; they know too well themselves that the preservation of the woods is identical with the increase of the value of their property.

When the constitution fails to force the individual to preserve the forests, the government ought to have the power to expropriate it for itself for a fair sum and take the management of the forests into its own hands. What part of said forests is sold or given away at the present time, will in a hundred years from to-day be bought by the government for immense sums; for the private person never gives things away as the government has done. And the incredible amount which the French government spends every year for improving foolishly destroyed forests, go to prove what a hard and expensive task it is.

As already mentioned it is a positive necessity to preserve the forest at places where the soil is mere sand or inclined to become swampy. This is the case in many parts of the country, especially in the south and south-east, where around the Gulf of Mexico and along the Atlantic Ocean we find thousands of square miles of this kind of soil. Large forests of the finest pines are destroyed every year and the new growth is often annihilated by fire. Already we can see the dry white sand looking through the thin grass. With the last tree and its shade even the latter will disappear. The heavy fertilizing rains even in those

countries cannot alter this state of things. Nothing is done by the government to prevent this. Maybe there exist laws concerning the preservation of the forest; but laws not enforced and laughed at by everybody are worse than no laws at all.

Wisconsin, Michigan and Minnesota are rich in valuable forests of pine and maple; many hundred square miles of swamps are covered with white cedar (*Thuja occidentalis*), spruce and balsam. These trees owe their existence to the heavy sphagnum moss that grows there; it offers room enough for the roots and separates them from the stagnant waters.

Different kinds of shrubberies grow on it in great variety. Fell those trees and soon the moss will disappear; the sunlight and the increasing warmth combined with the dryer air will soon replace it by flowers of another class. The soil is getting worse every day and soon will be almost unfit for cultivation. Already many citizens can tell about swamps, which at the present time nobody is able to pass, but which they remember being covered with dense forest.

The traveller from Europe is always surprised by the exceedingly long wooden railroad bridges over comparatively small rivers. In America almost all the rivers have their own free movement, their beds are one year here, the next year there. From their looks it is easy to judge the condition of the higher lands, where they come from.

Rivers, which always carry dirty water and, during the heavy rains, are swollen to considerable extent and take everywhere parts of lands away, come from a country where there is no forest at all or where by negligence the woods are almost annihilated. Such rivers we find in Ceylon, where the English, in order to extend their coffee, tea, and cinchona plantations, commenced with the destruction of the forests in the mountains; the same we see in Japan, Spain and North Italy. After every heavy rain people live in constant fear of inundations. The American rivers are partly in this state. It is an infallible proof that a change must have taken place, if a stream, whose sides are lined by trees hundreds of years old, commences during every long rain to undermine its banks and finally washes them with the trees away.

Instances like this speak better than any book written concerning this subject. The destruction of the forests in the Adirondacks by fire, and the fruitless trials to use these mountains for agricultural purposes, caused quite a change in the depth of the Hudson River, which even during the dry times received a considerable supply of water from the dense forests of the mountains. Peekskill used to be a water station of the N. Y. Central and Hudson R. R., but had to be abandoned, because during the dry season the salt water of the ocean came up as far as Tivoli; and salt water cannot be used for the filling of the locomotive boilers.

Many look indifferently at the devastation of the forests, believing themselves to be able to replace its beneficial effects by a great scheme. Their idea is to build enormous reservoirs, which could be filled during the rains with water and the contents of which could be used for the irrigation of the cultivated lands. But the filling of such a reservoir would need an immense area and we will hope the rains might never be too heavy, for the collapse of such a reservoir might be more fatal than a waterspout.

It seems better to me instead of investing immense sums in erection and keeping of those reservoirs, to use the money for buying up and preserving the mountain forests, where it would show that these natural reservoirs pay well, while the artificial ones only would absorb large sums every year. In spite of the terrible destruction of the forests in America, I believe at the present time it would take only very little help to bring a sufficient quantity of them back to their old condition, if it were only possible to keep the fire away from it.

Danger of fire in forests in the cultivated countries of Europe has become very rare; in case of it everybody would hasten to extinguish it as soon as possible. [Listen Americans! The government has there even a right to compel its citizens to help]. In India, owing to the energetic measures of the government and to its steady watchfulness, the number of forest fires is rapidly decreasing annually, while the younger growth is prospering. In the smaller country, in Japan, fires hardly ever occur, and the intelligent industrious people are busily engaged in building up their destroyed forests. In North America forest fires occur every day, and people generally look at them with indifference; what else could you expect from the descendants of a nation which has no forests, and so of course does not know how to appreciate their benefits.

It is not a very nice but an instructive chapter to study the causes of these fires; we can see what people are able to do in the country of the greatest personal liberty, whose laws for protection of forests, if they exist, are only humbug.

From the records of Prof. Sargent we see that in the single year 1879-1880, 480,960 ha. of forests, valued at about 100 million marks [\$25,000,000], were annihilated by fire. Incendiarism was mostly caused by timber thieves, who set the forest on fire to efface the traces of their thefts.

Regarding the Yellowstone Park, the wonderland and declared national property of the Union, Winsor, in his "Guide for Travellers" says: It is greatly to be deplored, that by the carelessness of camping visitors (mostly educated men) large parts of the finest forests were burned down. This fire broke out because the simplest care concerning camp-fires was neglected; therefore travellers in the park are now compelled to ride through miles of black stumps instead of under the refreshing shades of gigantic trees. People of refinement and means, as they seem to have been, ought to have been held responsible by law for the damages done by their carelessness; the amount could easily be fixed according to the value of the lost timber. The loss of the newer growth could not be ascertained, and besides, the forests suffer because capitalists will not invest their money as long as there is no government protection to secure them.

THE FOREST AS A NATIONAL RESOURCE.*

BY PROF. FERNOW, WASHINGTON.

In a paper which I read before this section last year, I classified the natural resources which serve the material progress of nations with reference to the position which the nation as a whole, the government, ought to take towards them. I endeavored to show more specially, that the most prominent functions of government in regard to these resources are or ought to be providential in their nature; that the State, in its very conception being an institution for the purpose of insuring not only our present but future and continued welfare of the community, must have an interest in the permanence and proper utilization of natural resources, upon which this welfare rests.

To restate briefly the classification, we found two principal classes, namely:

(a) Resources which yield directly the necessities or conveniences of life and form objects of industrial activity;

(b) Resources which serve indirectly the comforts of society, industry and progress of civilization, and do not form objects of industrial activity.

* Read at the meeting of the American Forestry Association, Quebec, 1890.

It is the former class of resources mainly, which, if left to individual control, are most apt to deteriorate and in regard to which the interests of the individual and the community are most frequently at variance, and it is most difficult to find the proper balance between permissible freedom or individual disposal and necessary restriction by communal interest.

In regard to the second class of resources, such as air, light, waterways, etc., the providential function of the State is much better understood and conceded, although even here the *laissez-faire* idiosyncrasists would give to individualism the widest latitude.

The resources which form objects on industrial activity were again divided, with reference to their continuity, into

1. Resources exhaustible and not restorable ;
2. Resources restorable, but liable to deterioration under increased activity ;
3. Resources restorable and apt to yield increased returns to increased activity.

To intelligently define the position which the State should take in the matter of protecting its resources against too rapid exhaustion or unnecessary deterioration, we must keep always in view the implied interest of the State in the future, and understand the nature of the resource, with reference to its future.

In this paper it is proposed to define the proper position of the State towards its forest resources, and for this purpose to investigate the nature of these resources.

It is questionable whether the forest itself may be considered a resource. It is in reality a crop, a product of the soil ; and the soil with its fertility is the resource proper, which can be turned to this use or to any other.

The forest primeval is nothing but a function of the fertility of the soil. As soon as the soil is not needed for other purposes more useful, this product of the soil may be valuable, and with means of transportation to a distant market, or as far as a home market exists, it may constitute a resource. As soon as with increasing population and hence demand for food-producing areas the occupation of the soil by wood-growth is a hindrance to its agricultural use, and by this antagonism the value of the forest resource is apt to depreciate in proportion to the need for food-areas, the wood product may become the opposite of valuable by necessitating its removal without a market for its disposal ; hence the burning log-pile of the pioneer settler, fed by the most valuable timbers. The need for cleared lands tends to diminish the occupation of the soil by wood-growth, until at last an equilibrium results, when the needs for food areas are satisfied and the requirements for wood material make a reservation of soil for forest growth desirable. When at last the stores of the virgin forest are exhausted and it becomes necessary to apply human ingenuity and management to the production of desirable quantities and qualities of wood material on a confined area, a new industry, forestry or forest management, arises, which exercises itself, like agriculture, upon the production of values from the soil.

So long, then, as the virgin forest is not placed under management, its stores represent the resource itself, and, being worked somewhat similarly to the mines, it is an exhaustible resource, differing, however, from such resources as the mines in its capacity of being reproducible. As long as the activity in working the forests is simply directed towards the extraction of the valuable material which nature has stored up for centuries, every increase in this activity means corresponding depreciation and depletion of the resource. As soon as the forest becomes an object of scientific management and artificial forest planting is resorted to, it is the soil and its fertility which is the actual resource, the tree-growth being a product of the same ; and then we may range it under the third

class of resources, which yield increased returns to an intelligent increased activity, this activity being exercised not in the direction of utilization but of reproduction.

While the virgin forest is worked, as it is in the United States and Canada, simply taking out the material wanted without any regard to its continuance, it represents, as has been stated, almost like a mine, an exhaustible resource; for although reproduction is possible, and in reality occurs, under the regardless methods of utilization not only is the reproduction very partial, but where the better kinds of timber are culled the reproduction can only be of inferior kinds, and the quality of the resource is therefore reduced.

In addition to the irrational method of utilization, which tends to deteriorate the resource, the disastrous fires which overrun the forest areas of the United States annually destroy the accumulated leaf-mould of centuries, thus reducing the fertility, killing the young growth, and, in the end, especially on the hillsides and mountain slopes where, by the baring of the ground the beating rains are allowed to wash off the soil, reforestation is made almost impossible, so that in the end the resource—whether the growth be considered as such or only the soil and its fertility, is exhausted.

But besides furnishing directly wood and incidentally other valuable products, which either as raw material or in manufactured form supply a large number of human wants, the forest at the same time by its functions in the circulation of air and water exercises an influence upon cultural, climatic and sanitary conditions, which classes it to that extent with those resources, which, like air and water itself, are, though indirectly yet most indispensably connected with material and cultural progress, and are of the greatest interest to the nation; so that in considering the position of the State towards forests and forestry, we will have to keep in view these two aspects of the forest—its material value and its cultural function.

The value of any material resource is measured, in the first place, by its comparative abundance. Other factors which enter into the valuation are the demand for it, the ease with which it can be obtained and brought to centers of consumption, the possibility and ease of reproduction; its necessity for our present civilization or more or less easy replacement by other materials may also influence the valuation.

I.—THE FOREST AS A PRODUCER OF MATERIAL.

As regards the natural reproduction and the consequent abundance of the virgin forest, it may be said that the whole earth is a potential forest. That is to say, with the exception of a comparatively small area—in elevation above timber-line in north and southward distribution beyond eternal frost line, in continental distribution, within rainless deserts and soil-less rocks—tree growth would ultimately prevail on the entire land surface, provided the interference of animal or human life were checked.

This interference, however, has reduced the forest area in all parts of the world. It has, no doubt, been largely instrumental in creating the vast prairie regions and treeless plains which are found on every continent, and which, but for the continued interference, would gradually, at least within geologic ages reclothe themselves with tree-growth, with few exceptions.

If originally the land area represented an almost uninterrupted forest area animal and human activity has changed the face of the earth considerably. This change has taken place partly to satisfy the needs of increasing masses of population for food areas, partly without such need by reckless destruction; so

that density of population cannot alone account for present distribution of forest areas, but historical development of the people, their progress in civilization or relapse into comparative barbarism and natural conditions of the countries have had a bearing.

Thus, while Norway and Sweden, with scanty population showed, until recently, when an active export business of wood reduced their forest areas, a large proportion of woodland; in Spain and Greece, although the population diminished with the decline of culture, reforestation has not increased in proportion, and we find small forest area together with scanty population. In Germany economic development and early recognition of the value of the resource and necessity for its rational use and management has preserved a proportionately large area.

In the United States the proportion of forest area to population since its settlement by European races has rapidly declined. Here almost one-half of the continent had by adverse climatic conditions, supplemented probably by the destructive agencies of beast and man of earlier civilization, been deprived of its tree-cover.

To such an extent has human activity reduced forest areas that in those countries where it has been most active the proportions have dwindled down to even three per cent. of the land area.

Taking Europe altogether, not much over thirty per cent. or $2\frac{1}{2}$ acres per capita remains in forest, and in the United States the forest area represents probably not more than twenty-five per cent. or seven acres per capita of population.

The demand for forest products is perhaps nowhere greater than in the United States, probably not less than six to eight times as large as in Europe.

In Germany, with a population at least twelve times as dense as the United States—and hence the need of strict economy with all exhaustible resources—the annual consumption per capita may be set at round 45 cubic feet.

The annual production of the well-managed forest areas of Germany is found to average 55 cubic feet of wood per acre; there should, therefore, be 0.8 acres per capita, which very nearly is the case, (0.79 acres), the small deficiency being made up by imports, the excess of imports over exports being about 60 million cubic feet. In the United States we use simply the accumulation of material through centuries in the virgin forest, the second growth furnishing but a small part, and of management for reproduction or increased yield there is as yet no sign.

In the virgin forest the product per acre varies to such an extent that it would be impossible to make even a reasonable guess as to available supplies; some of the pine forests of the South may cut no more than 200 or 300 cubic feet, while some areas on the Pacific Coast may yield 15 to 20,000 feet and more. If we apply the experience of Germany as to possible annual wood production per acre, we will find that our present forest area, if properly stocked and well managed, would suffice to furnish our present demands of 20 to 25 billion cubic feet. But we know that the premises do not exist. The manner of utilizing the product has also much to do in calculating the efficiency of the producing area.

While, for instance, in the forest management of various German States the percentage of entire wood material may be said to be utilized in some shape or other; in the United States a very large part is not utilized at all and left in the woods; and while in the German forests from 40 to 65 per cent. appears as building timber, we learn that less than 30 per cent. is the yield from the red woods of the Pacific Coast; and, take it all through, it is doubtful whether more than 25 per cent. of the actual wood in a tree is utilized in the United States

In comparing supplies and demand, it would be a mistake to place reliance on calculations of the wood accretion upon the areas under forest cover, for it is quality of material that is demanded, and not mere quantity. Not only do areas differ in their wood-producing capacities according to climatic and soil conditions, but their composition as to kinds of trees and quality of timber determines their value. Thus, while the area of forest in the United States probably does not diminish now at as rapid a rate as it used to, the value of the remaining area is very rapidly depreciated, not only by removing the accumulated supplies, but by culling the best and leaving the inferior material, by neglecting to give attention to the reproduction of the better kinds, or even by recurring fires destroying the capacity for such reproduction.

The forest furnishes firewood, building timber and raw material for the arts.

In the United States more than three-fifths of the population uses wood exclusively for fuel, and to show the value and appreciation of this class of fuel in comparison with substitutes, it may be mentioned that in Germany during 75 years from the beginning of the century the price of coal has constantly sunk, while that of charcoal has constantly increased; showing that the substitute not only did not displace, but did not even affect the valuation of wood as fuel.

The bulkiness of the material when compared with its heating power is objectionable, but other qualities make it desirable.

For building purposes, although stone, iron and other materials are used more and more, the ease of shaping wood material, the rapidity with which it can be handled, and various other qualities, will insure the use of wood for that purpose for all time. In the arts the same qualities make the use of wood desirable, and while substitutes in many cases are even preferable, in others the necessity for using them would entail grave inconveniences. The value of sawed wood material in the United States is calculated as round one billion dollars, representing an enormous amount of material. One of the drawbacks of the material is that it is comparatively bulky, and hence it is desirable not to have to transport it too great distances, especially overland, but to produce it not too distant from the centres of consumption. In the United States, with many thousands of acres of virgin timber to draw upon, the price for lumber represents hardly more than the expense of getting it out and transporting it, the material itself representing not as yet any cost of production.

II. THE FOREST AS A CONDITION OF CULTURE.

The value of forest areas in influencing climatic soil and water conditions has been generally recognized only during the last 100 years.

While there exists, no doubt, under given conditions, a relation between forest-cover and climate, all generalizations in this respect must be taken with caution, until more proof and exact data is brought by scientific methods. Climatic conditions are, in the first place, due to cosmic and terrestrial influences. Of the terrestrial influences we know mountain ranges and water surfaces to be powerful. There is not only reason to believe, and some definite measurements sustain the belief, that as far as forest-cover interferes with insulation of the earth and the movement of air currents it renders the climatic conditions within its own borders different from what they would be were the forest-cover removed. The doubt can exist only as to whether and to what extent this difference can make itself felt outside of the forest. The claims are, that a forest-cover tempers like a water surface, and, to some extent, intercepts or reduces the

force of hot and cold winds with all the consequence of such action; further, that it influences, if not the amount yet in local and temporal distribution, the precipitation of rain and snow, besides exerting various minor influences.

Whatever the truth—and neither the claimants nor the objectors to forest climatic influences have brought incontrovertible proof—it is evident that the extent, composition and location of the forest must have much significance in the matter, and also that the relation of the country towards other climatic influences must either increase or decrease the significance of this factor as a climatic element. In England, under powerful terrestrial tempering influences, any forest influence would be inappreciable by comparison; poor thirsty Spain, on the contrary, deprived by its situation of the effects of modifying ocean currents, might possibly modify the extremes of temperature under which it suffers by extensive forest areas, which it lacks. While our own North Pacific coast, if stripped of her wonderful forest wealth, would not be appreciably deprived of its abundant rainfall brought by the ocean currents; properly disposed timber belts in our arid and sub-arid interior might, if not increase precipitation, at least check the excessive evaporation under which it suffers from the incessant and unchecked winds.

The cool and humid forest-cover situated on the slope toward the moisture-bearing winds may unnecessarily increase the tendency to condensation to which the currents by their mere descent are subject, while if situated on the leeward side might recuperate itself from the moist forest air, the drained current coming over the mountain. Here, by obstructing the gentle south wind, it may keep a valley longer in the rigors of winter; there, by cutting off the cooling breezes, it may make less bearable the heat of summer. So that an objectionable influence may be shown as well as a favorable one, according to local conditions.

With more assurance can we speak of the influence which the forest-cover exerts upon the soil and water conditions. Again, it is the location with reference to the configuration and geologic formation which imparts the value to the forest, and hence, again, generalization is not permissible. Here, where an excess of moisture due to subsoil conditions used to be removed by the process of vegetation, deforestation induces the formation of marshes, and in consequence unfavorable sanitary influences on the surroundings may result; there, under different conditions, where evaporation had been checked by the forest, its removal reduces the humidity of the soil and the size and continuity of springs. Remove it from the shifting sands of the coast and the formation of sand dunes encroaching on the agricultural lands is induced; burn the forest floor on the sandy gulf coast plains and you destroy its fertility; burn the litter that accumulates under the forest-cover on the mountain slopes and the waters will run riot and gully the ground; torrents, landslides, snowslides, avalanches are induced, washouts filling the valley and the river with debris, causing stow-waters and increasing, if not producing, floods.

The significance then of the forest under given conditions as an important factor in the general conditions of a country cannot be denied.

Lastly, when we consider that forest-growth is capable of producing values on ground which cannot be utilized profitably in any other way, its significance as a national resource may be considered sufficiently established by this brief exhibit. This latter capacity of forest-growth is of the more significance when we look over the world and count the waste places which man has produced. There are in France and Germany alone over 500 square miles of sand dunes, which France has shown by a reforestation of nearly 300 square miles can be profitably utilized. In Austria the waste places capable of reforesta-

tion are nearly 2,000 square miles; in Italy, 1,500; in France, nearly 10,000 square miles; in Great Britain and Ireland, over 11 per cent.; in Greece, over 15 per cent. of the area is waste, while in Germany only 2.7 per cent.

Hence, of late, all these governments strive to bring these vast unproductive areas into useful occupancy. Prussia spends \$250,000 yearly in that direction. France has spent round \$30,000,000 within the last 25 years in recuperating devastated forest areas, and even Prussia has, since 1843, reclothed over 50,000 acres of her steppe.

We have seen that, as a meteorological and cultural element, the location of the forest is all-important, and its most pronounced value as such element is found on the mountain-sides, on shifting sands and on the poorest soil, in general; that is to say those locations where the material product must be necessarily inferior to that of better situations and where, therefore, forestry is least profitable. They are the very areas where private activity can find satisfaction only, by reaping the natural crop. Yet here the danger from mis-management—that is a management in which no regard is taken of the simultaneous or immediate reproduction when the crop is harvested—must be the greatest, since the baring of the slopes and sand soils may mean destruction of fertility, not only of the bared but also of the adjoining areas, and increasing dangers from flood waters. Hence the interest of the community must be centered upon these forest areas.

It has been contended that the reproduction of forest-growth takes place of its own accord, and hence the interest of the State as far as material production is concerned, need be only of that general character which it has in all products and industries of the nation.

This contention, however, is erroneous if considered from an economical point of view. While culled and denuded areas do reproduce a wood-growth, this—in quality and especially in quantity per acre—is only in rare cases satisfactory and economical. The reckless squandering of material, the disregard to the condition of the area after being left by the lumberman, the practice of firing and thereby destroying the young growth as well as the fertility of the soil, are to a large extent detrimental to the reproduction of the resource, and experiences all over the world have shown that by such reckless policy recuperation can be rendered almost impossible.

As far as the production of material constitutes the forest as a resource, it is not tree-growth merely but quality of the growth that makes it valuable, just as it is not the presence of iron but its sufficiency and quality in the ore, that makes the iron mine of value. The forest primeval contains much material which is of little or no value and large areas are required to produce small amounts of good timber, but in its reproduction it can be improved in value and yield, and that without anything but proper use and management.

From agricultural and horticultural products of the soil the forest distinguishes itself, in so far as the former in most cases are improvements upon the natural product in kind by means of human ingenuity and labor, while the natural product as it is found in the virgin forest satisfies the needs of man.

An important difference, too, and one which makes the use of the soil for forest-growth as an economical element desirable, is, that while agricultural crops exhaust soils of their fertile elements, wood-growth does not rely on these to any extent, returns the larger amount of those utilized by the fall of leaves and branches, and improves thereby the soil for agricultural use.

The production of starch or sugar and albuminoids, which is the object of agriculture, takes place at the expense of the minerals in the soil which are carried off with the yearly crop, while forest products, being in the main cellulose and its derivatives, are formed at the expense of the inexhaustible carbon of

the atmosphere; and, although small quantities of the rarer minerals are also required, they are used over and over again for processes of assimilation from year to year, since the crop is not removed annually; and when it comes to harvesting, those parts of the tree which contain most of these minerals, the foliage and litter, remain on the ground. Thus a potato field for a medium crop requires three times as much of the rare phosphoric acid as a beech growth, five times as much as a spruce forest, and nine times the requirement of an acre of pine, while the consumption of potash is nine, thirteen and seventeen times, respectively, as great.

Hence the capacity of forest growth to utilize those soils which have been exhausted by agricultural use; and by the deep going roots mineral elements are raised to the surface and the soil improved.

Forest growth makes also less demand upon favorable topographical and climatic situation and will succeed where agriculture is not any more profitable or is impossible. Hence we may speak of absolute forest soils, that is soils which on account of their poverty, steep topography and climatic ill-favor are not fit for anything but forest-growth. The extent of what can be considered such absolute forest soil depends somewhat on the state of culture of the country. But it is a fact of highest national interest, that inferior soils and impracticable sites can be profitably utilized by forest-growth.

The main difference between forestry and other productive industries is the long period of production.

From the time of planting to the time of harvest many decades may pass and a century may not be too long. As long as it is not only wood but size and quality that is wanted, the factor of time is an important one, for it takes time to produce both size and quality. There are to be sure some uses for which timber may be grown in short rotations, as, for instance, where only firewood or posts or tanbark is wanted, but these uses are confined in extent.

When we consider not merely the virgin forest growth but a rational forest management, we find that it differs from agriculture in various financial aspects. In agriculture the soil alone is the standing capital or basis of production from which annually the interest is derived in the crop. In forestry the soil, plus a certain amount of growth, is the producing basis; only a part of the growing crop can be utilized annually, the rest, remaining for further accumulations, must be considered as part of the fixed capital.

This condition at least prevails where an annual revenue is to be derived from the business. It is of course possible to work for an intermittent revenue, waiting until the entire growth has reached the age for utilization and after harvest starting the new crop for another rotation; but this is not the most profitable way, and in the end it may be irrelevant financially, whether we conceive the growing crop partly as a capital or simply as an accumulation of revenue which we may not utilize.

To make a regulated forest management possible and profitable, to yield sufficient annual returns and to occupy the manager fully, a larger extent of territory is required than in agriculture; hence a larger standing capital is required. Agriculture, on the other hand, while needing comparatively small fixed capital, requires a comparatively larger running capital for expenses.

The existence of this stock in forest management places it in a particular position with reference to insurance and credit systems and the question of renting.

There are dangers threatening this stock which make forest property hazardous, more or less so according to locality, kind of timber, kind of management and moral sense of the population.

In the United States the danger from fire makes forestry one of the unsafest industries, and theft, it would appear, endangers it about as much. Insect ravages are the bane of the cultivated forests of Europe. But what they will be in the United States—the El dorado of vermin—when forest management has begun in earnest and hence the damage is felt more severely, is hardly conceivable.

The damage differs in value with the age of the growth. Fire may destroy the accumulated stock and crop of centuries; insects may destroy the saplings and grubs kill the young seedling growth. Windfalls or tornadoes may interfere with the regular system of management and may make a utilization of the stock necessary before its maturity, and thus occasion an overstocking of the market and decline of values.

While there are some dangers in agriculture, such as unfavorable weather, frosts, etc., that are not at all or to less extent felt in forestry, it is there only one year's crop that suffers, while here accumulated stores are exposed to hazard.

Since the main value of forest property lies in the accumulated stock, the soil being mostly of inferior value, and this stock is most exposed to depreciation and depredation, it does not form a fit object for credit, nor is it for the same reasons a desirable property to rent. The stock is all the year round exposed to the depredations of others, hence it requires a comparatively large expenditure for protection simply. The existence of this stock is also apt to prove dangerous as far as the proprietor himself is concerned, for it offers a constant temptation to utilize it at the expense of a rational management. Necessity, folly, or miscalculation may easily diminish it, while to place it again upon its proper value and quantity is difficult. Hence, if it is in the interest of the community to maintain stable conditions of property or where the forest partakes of the protective quality, more special care in regard to the laws regulating forest property seems necessary.

Roscher says:—

“Where the sale of property becomes jobbing, *i.e.*, where it is purchased not to be managed, but to be sold as soon as possible for the purpose of pocketing the difference in price, agriculture declines; but with forests such abuse of property in soil is much more dangerous on account of the characteristics of forest management, so that here slow change of proprietorship is proportionately much more advantageous.”

The labor conditions in forest management are also worthy of note. Less labor is required here than in agriculture, since cropping and harvest recur only at the end of the long period of rotation, and the work of cultivation is connected mainly with harvest of material. Yet while few laborers are needed for their full time a large number is given work at a time when work in agricultural pursuits is slack.

According to statistics from German Government forests, agriculture employs from ten to even thirty times as much labor per acre as forestry; of the class of foremen, inspectors and similiar occupations, one man is needed for every 200 or 300 acres in agriculture, while to one forest-guard 500 to 1,800, and to one district-manager 5,000 to 15,000 acres are calculated.

Altogether, the forest offers less employment to labor than agriculture; the factor of nature has more sway in it.

This may have been the reason, why everywhere, the idea of private ownership in this kind of property has developed slowly and less regard to property rights on it is paid.

Further differences between agriculture and forestry are found in the conditions of transportation and market. The bulkiness and heaviness of the material make transportation difficult and comparatively expensive, so that the cheaper grades, especially firewood, may not be profitably utilized.

It has been figured out by a good mathematician (Little) that if it were necessary to convey the amount of timber annually consumed in America from foreign ports, the entire sailing tonnage of the world would be required.

With undeveloped means of transportation, the market for wood is locally circumscribed, and hence unprofitable, an intensive utilization of the crop is precluded and the best management often impossible.

As to profitableness of the business, this depends on so many factors and conditions that it cannot be easily determined in a general way. Although the profits per acre resulting from European forest management seems exceedingly low, it must not be forgotten that this profit is derived from the poorest soils and with little expenditure of working capital.

In Prussia, for ten years, the revenue for the entire forest area of the Government was \$1.92 per acre; in Saxony, \$5.60; in the very profitable forest management of Zurich, \$6.45; and on about 10,000,000 acres of German Government forest area, it averaged \$2.89; while agricultural land brought, according to crops, buckwheat from \$8.75 to \$96.00 per acre tobacco, annual income.

Excepting, therefore, the poorer soil and special conditions and kinds of management (for instance, coppice management of short rotation for tanbark), agriculture is more profitable.

During the long time necessary for production in forestry, the conditions may change to such an extent that what appeared a profitable undertaking when begun, by change of circumstances becomes unprofitable. The difficulties in gauging and balancing supply and demand may also be considered to some extent less easily overcome. On the other hand, the possibility of delaying the harvest or cutting it earlier, according to market conditions, is an advantage in forestry. It is also possible to store the harvest without the detriment or expense which agricultural crops would entail.

Since forest management does not admit of rapid changes in plans and method, but requires a conservative and well-matured plan, not only should the forest manager command a considerable scientific education and knowledge, but he must have determined character which is capable of carrying through a policy upon which he has decided. Forest management implies and fosters stability and conservatism.

Having conceived the State as an association for the purpose of regulating and adjusting the differences of private and communal interests and rights, and having agreed that the preservation of favorable conditions for associated life, that the interest of the future community is as much the concern of the State as the protection of the present community; we may now more specifically define the position of the State with reference to the forest resources.

The State must be guided by the principle, that as much latitude should be left to private activity and property rights as is compatible with the interests of the community, only when this activity and exercise of property right is demonstrably and directly harmful to communal interests is State interference called for. The individual must be guided by the rejoinder of the Roman law: "*Utere tuo ne alienum noceas.*"

With increasing population and more complex civilization, it is but natural that friction of contending interests should grow more pronounced and at more points; the present socialistic and communistic tendencies are therefore a natural development from the change of conditions in social life. As elbow-room gets

scarcer, elbows more frequently knock against each other and poke into the sides of neighbors. Hence more points are discovered where interests are at variance and the principle of preventing use of private rights to the detriment of the community needs to be more carefully enforced.

While with a large virgin forest-resource to draw upon and a small population, in the United States the government paid but little concern to the disposal of forest land and forest supplies; with a reduction of the latter and with increased requirements for the same, at least such ameliorative government action is called for as will aid private interest to utilize the resource more rationally and to better advantage for continued yield and future supplies.

Since, in most cases, the resource is capable of restoration, the widest latitude to private activity should be granted, and the office of the State should be mainly directed to remove hindrances to a full development of a rational forest management and offer such positive encouragement as can be given by proper protection, by fostering educational agencies, and in similar ways.

The State agencies which are employed to facilitate a knowledge of market conditions for agricultural crops and of crop areas are, perhaps, still more desirable in the case of forest areas and cut and demand, since it is more difficult to determine these.

As far as production of wood material is concerned—a profitable private industry—and the use of the soil in the most profitable manner, it may be presumed that private interest is identical with that of the community and will adjust itself accordingly; although this axiom can hardly be said to be recognized everywhere, as the poor mountain farms in the Adirondacks and elsewhere show.

It will, however, have been observed that the nature of forest property to forest management is such as to make large and continuous holdings desirable. Hence, if the State—the community at large—does not itself retain the ownership of its forest area, it should encourage the aggregation of large forest areas in the hands of strong capitalists, individuals or corporations.

The providential and restrictive function of the State is first called into play when, by the wrong treatment of a forest, a neighbour may be injured in the enjoyment of his own property, or when the cultural conditions of whole sections of country are endangered by the free exercise of property-rights on forest areas.

Whether such injury is done or is to be expected from such unrestricted exercise of private rights is often difficult to determine. Our knowledge of the relation of natural agencies is by no means so well established as to allow us definite prediction.

On the other hand, there are certain conditions under the consequences of forest destruction or forest devastation which are so well understood that State supervision in one shape or other can reasonably be claimed to be rational.

The effect of the deforestation on sand dunes has been experienced in Southern France and elsewhere to the fullest extent; just so the effect of mismanagement and deforestation of steep mountain sides, which demonstrably give rise to depauperization of whole districts and communities, by washing of the soil, irregular water flow and increased flood dangers. Climatic influences, with the exception of reducing the detrimental action of winds, are, perhaps, less easily demonstrated.

Such forest property, then, cannot be left to the absolute control of the private owner. Since, however, he should be compensated for the restriction which he has to suffer for the public welfare, and since the damage done or to be expected may not always be easily proved or estimated in its extent and amount, the only proper solution is State ownership of the property. And by State

ownership I do not mean to imply that the State or the General Government should necessarily be understood; I mean the community—be it State, county or township—the interests of which are at stake as against the private interest. To be sure as a rule, it will be found that the interest of several towns, counties, or even states are concerned in the control of private occupancy, and the strong, immutable, conservative central government will be found the best agency to control or own the mountain forests at least. Such ownership has the advantage of securing the object in view, while any restrictions of private rights are cumbersome and difficult to enforce.

Besides, as such forests are situated mainly on the thinner soils and rugged slopes of mountains, and, hence, are not only less profitably worked, but their reproduction is connected with difficulty and, if improperly treated, may become almost impossible; they form a questionable object for private industry in which financial gain is the leading principle.

The states which have recognized most fully the need of Government control of the forest resources are the English colonies—notably those of Australia and India—states from which we can learn a good deal in methods of internal improvements. They have done more than consider the protective function of the forest, they have recognized that the uncertainty and great fluctuation of supplies which, on account of the peculiar nature of forest property, must result from private forest management, is undesirable, and hence have reserved large areas and placed them under government management.

All other civilized governments, excepting those of the American continent, have more or less applied the principles here laid down. Canada, while disposing of its forest supplies to private individuals, does so under restrictions, and reserves at least the land; Germany, with 32.2 per cent. of state forest, 18.7 per cent. of communal forest, and 30 per cent. of the private forest under more or less state supervision, thus attempts to keep secure 65.5 per cent. of her forest area. Austria, France, Italy, Switzerland, all having state forests, also control the management of their protective forests, and the tendency everywhere is to enlarge the restrictive power of the State.

While here state-ownership and restriction of private rights is directed toward maintaining favorable forest conditions, the reforestation of devastated and treeless areas forms also a proper subject for the State.

Such State action of an ameliorative nature would be based upon the principle, that the State, the community, should act where the exertions of the single individual or even voluntary association of individuals is powerless, or private interest does not find sufficient inducement to attain an important economic object, where the communal interest is better subserved by the action of the State, when permanent institutions are to be created and managed independently of personal whim, and the State alone can insure permanence, continuity and the accomplishment of the object.

Hence the reforestation of the Western plains, for purposes of ameliorating cultural conditions, would be properly delegated to the State, especially as long as the State still controls the land necessary for such forest planting. Feeble attempts to encourage private enterprise in that direction have been made with little result, and much of the private energy expended upon the problem has been dead loss to the individual and to the nation, for the reason that only by concerted action on a large scale is successful reforestation in the arid regions to be expected.

The method of assisting private enterprise, in any other way than by creating opportunities, is the least commendable, creating as it does a paternalism

which would be a bane to the development of proper self-government, and which is widely different from the communal spirit which the writer has advocated in his propositions.

Summarizing the special considerations and peculiarities pertaining to forest growth and forestry which may influence State action, they can be briefly stated as follows:

1. By its location upon mountain slopes, sand dunes and otherwise, the forest may represent a climatic and cultural condition of paramount importance, which renders its material value a secondary consideration.

2. By mismanagement or neglect the capacity for reproduction may be injured to such an extent as to make reforestation impracticable, if not impossible.

3. Forest growth improves instead of exhausting the fertility of the soil, and is capable of producing useful material on the poorest soils and sites.

4. By proper methods of utilization alone reproduction of the virgin forest superior in quality and yield can be effected.

5. Forestry differs from other industries in the long period of production, necessitating an accumulation of stocks, which is exposed to various dangers for a long period of time, and hence renders the business hazardous.

6. Forestry requires large areas and a large fixed capital, but only small running capital. It employs little labour, but furnishes employment at seasons when elsewhere labour is less needed.

7. As a financial investment, forestry is beset with many drawbacks, which render it less desirable for private enterprise; the necessity of keeping on hand a large stock exposed to danger renders it not a desirable object for financial operations.

8. Forestry engenders and requires permanence, continuity of plans, management and conservatism.

Ontario Forestry, 1891
7/12

ANNUAL REPORT

OF THE

CLERK OF FORESTRY

FOR THE

PROVINCE OF ONTARIO

1891.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.



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SEVENTH ANNUAL REPORT

OF THE

CLERK OF FORESTRY.

To the Honorable the Minister of Agriculture :

SIR,—I have the honor to present my Report on Forestry for the Province of Ontario for the year 1891, the leading features of which are :

A report on the condition of thirty-two counties and districts of Ontario as regards the amount and quality of the timber remaining, the steps taken, if any, with a view to reforestation or preservation of the woodlands, and the effect of over-clearance upon the climate and agricultural conditions.

An address on "The Value and Uses of Forests," delivered to the students of Upper Canada College, embracing the elementary principles of forestry.

An account of the process and results of the work of reforestation in France.

Papers on Forestry in the United States, the National Parks and the proposed Adirondack Park in New York State, giving an insight into the work undertaken by the American National and State Governments for maintaining park reservations in regions specially adapted for the purpose.

Extracts from prominent scientific authorities showing the influence of forests on climate.

An article on "Arbor Day in Schools," giving an account of the rise, progress and results of this beneficial observance.

A paper on Utilising Poor Farming Land, showing farmers and others the practical benefits of devoting to tree-planting land which is manifestly unsuited to profitable cultivation.

Extracts from a bulletin issued by Prof. E. B. Fernow, Chief of the Forestry Division of the U.S. Department of Agriculture, entitled "What is Forestry?"

A number of papers, partly original and partly selected, upon various phases of the subject of forestry and tree-planting.

It has been my aim to keep in touch with the most progressive and practical thought of the day on the science of forestry, and to present in a condensed form the best that is to be gathered, both from classic and contemporary literature bearing on the question.

The pamphlet is necessarily largely a compilation, as it would be impossible with the resources at my command to obtain such information at first hand.

Respectfully,

R. W. PHIPPS.

FORESTRY REPORT 1891.

FORESTRY CONDITIONS OF ONTARIO COUNTIES.

In the following paragraphs I have endeavored to lay before you the state of many of our settled counties in Ontario regarding their condition as to timbered land. Much of this information has been derived from actual observation, and the remainder from those supposed to be best aware of the condition of the country round them. In most of these counties it will be observed that the forest is being thinned out far too rapidly. Blocks of forest are being destroyed at a merely nominal value. Undoubtedly in many of the front townships farmers are planting long lines of trees, but these cannot give future timber. An isolated tree grows to branches. Throughout settled Ontario, if anything is to be done to preserve our timber resources it must be by the use of plantations, acres in extent. In these timber will grow in long, straight sticks, as in the primeval forest, fit for any use the farmer may desire. If he cannot in his heart allow a few of his acres to be devoted to that purpose, he will in a few years find himself utterly destitute of the wood he needs. Farmers are now in every direction purchasing at a distance lots for fuel.

In a great many cases the laying out of a plantation on the farm would not necessitate the withdrawal of any valuable agricultural land from cultivation. On many farms a portion of the land is so hilly, broken, or rocky as to be of little or no use. Tracts of this character are often allowed to lie waste when a comparatively little expenditure of labor and means employed in planting them with suitable kinds of timber would render them profitable, not only on account of the intrinsic value of the timber, but as a protection to the adjoining fields.

The testimony of old residents is practically unanimous as to the injurious effect of the clearing of the country on the streams and rivers. In all quarters the result has been the same. Heavy floods in the spring season, or after violent rainstorms, have often caused serious injury, carrying away in a few days the volume of water which would formerly have flowed off gradually and without injury. On the other hand, streams which formerly ran all the year round are now dried up during the summer months, and drouths are severely felt, and cause the farmer much loss and inconvenience. Had a due proportion of forest been maintained, especially on the higher grounds about the head-waters of the streams, these evils would have been greatly lessened, if not altogether averted.

There is also a general agreement of opinion among farmers in all parts of the province as to the benefits of the protection afforded by forests and windbreaks to the fall wheat and clover crops. The principal danger to which these crops are subject is the effects of alternate frost and thaw towards the end of winter or in early spring, by which the plants are lifted out of the ground and winter-killed. This generally takes place when the snow has been drifted off by the wind, leaving the soil exposed. Belts of timber to the windward of the crop—in most localities on the north or west side—intercept the wind and prevent the snow from drifting, so that crops thus sheltered stand a much better chance of survival than if the neighborhood were bare of trees. It has also been noticed in some districts that orchards thrive better and yield more fruit when sheltered from the wind in the same manner.

The planting of windbreaks to afford protection to the fields has only as yet been done to a limited extent, mainly in the older settled counties; but there is a decided advance of public opinion on the subject. Wherever the trees have attained sufficient growth to enable any conclusion to be drawn as to their utility, the farmers are fully satisfied with the result. As might be expected, there is much difference of opinion as to preferable

varieties of trees for this purpose, much depending upon the conditions of soil and locality. The principle, however, seems to be established that evergreens, if successfully grown, answer the purpose of a windbreak more effectually than deciduous trees, for the obvious reason that the latter are bare of foliage at the season when their protection is most needed.

As to the course which ought to be followed to maintain a proper proportion of timbered land, a great variety of suggestions, practical and otherwise, has been offered. The subject divides itself into two heads, viz., the plan to be pursued as regards unsettled land not fitted for agriculture, and the best methods of inducing farmers and land owners in the settled localities to plant or preserve timber on their own property. As to the first branch of the subject there is a strong and general feeling among intelligent residents of the back townships that greater precautions are needed for the prevention of bush fires, and that it would be advisable to withdraw from settlement large areas of land obviously unsuited for agriculture and maintain them permanently in timber, under proper forestry regulations, instead of allowing them to be stripped of all merchantable timber in a wasteful and improvident manner, and then abandoned as waste land.

With regard to encouraging tree planting among the farmers, one point which has been prominently brought out in the course of my enquiries is that some form of Government or municipal encouragement is necessary to induce farmers, as a class, to take an active interest in the matter. The Ontario Tree Planting Act has only been taken advantage of in a few localities. A proposal which has numerous advocates is that plantations, or land preserved in timber, should be exempted from taxation, a certain extent only being thus exempt in proportion to the total acreage held.

BRANT.

The greater portion of the land of this county is well adapted for cultivation, there being few rocky or stony tracts. About fifty per cent. of the surface acreage is level, thirty-five per cent. undulating, and the remainder hilly. Probably about one-quarter of the total area would be more valuable to the owners if left wooded and carefully culled than as agricultural land. Not more than ten per cent. is now timbered, and that, as a rule, is not properly managed, and now contains little valuable timber. The leading varieties to be found are beech, hard and soft maple, elm, basswood and black ash. There is but little pine and white oak, or any other timber suitable for manufacturing left.

Many living springs and streams, once unfailing, have entirely disappeared, and the water supply is very uncertain. It is found necessary to dig wells much deeper than formerly to secure water for domestic purposes. Drouths have of late been severe. The absence of forests, which not merely acted as a reservoir of moisture but protected the farms from drying winds during the summer, has undoubtedly resulted in making the effects of drouths more injuriously felt, irrespective of any influence on the actual rainfall.

It has been found that wherever fields are sheltered by timber wheat and clover are very seldom winter-killed. The beneficial effect of forest protection has also been observed as regards other crops, and more especially orchards, which thrive far better when thus sheltered from the wind.

A few windbreaks, or rows of ornamental trees, have been planted with good results, the fir tree being principally used for this purpose. Nearly all the wood-lots are used for pasturing cattle, and in consequence much of the timber is dying out. Neglect of the growing timber is very general among the farmers.

BRUCE.

About one-half of the county of Bruce is cleared land but the area yet in timber is being rapidly diminished, and unless some means are adopted to prevent the indiscriminate destruction of the woods, evils which have resulted in the older-settled counties

from this cause will repeat themselves here. The general character of the surface is rolling; the land is for the most part suited for cultivation, but some portions are rocky and sterile and might with advantage be reserved for forestry, as trees grow well in these parts.

The most numerously represented kinds of trees are the cedar, hemlock, basswood, maple, white and black ash. There are only a few pine left. The clearing of the country has not been sufficiently general to affect the streams and cause the alternate floods and drouths which are so noticeable a result in the older portions of the province. For the same reason there has been no appreciable amount of tree-planting, and it is difficult to induce the settlers to take any interest in the question or to realise the need of maintaining a due proportion of forest land. Practical experience has abundantly demonstrated the utility of the shelter afforded by the forest to the fall wheat and clover crop.

CARLETON.

Only about five per cent. of timbered land remains in this county. The leading species of trees which are still to be found are elm, ash, beech, birch, cedar, tamarack, spruce, and some pine. The greater portion of the county is level, cultivable lands, but there are some stretches of flat rock unadapted either for agriculture or forestry.

The effect of the extensive deforestation of the country on rivers and streams has not been so noticeable here as in nearly all other localities. The most important climatic change which it has occasioned is that the severity of the wind in winter and early spring is felt to a greater degree. Since the disappearance of forest shelter the wind has in many places an unbroken sweep for miles, and the fields are consequently drifted bare of snow and the crops exposed to the severity of the frost. But little fall wheat is grown in the county.

There have been no windbreaks planted, and little interest is displayed by the farmers in the subject of forest preservation. The woods which still remain are fast diminishing. The practice of permitting cattle to find pasture in the wood lots to the great injury of the young trees is very generally pursued.

DUFFERIN.

With the exception of Melancthon and East Luther townships, which are still under the process of clearing for settlement, the proportion of timbered to cleared land in Dufferin does not much exceed five per cent. The leading varieties of trees remaining are tamarack, hemlock, spruce, cedar, maple, beech, elm, birch and ash. The land is level or slightly rolling, except in Mono and Mulmur townships, which are hilly and rough in places with sandy soil. These latter localities are well adapted for tree planting. They were formerly wooded, but have been cleared by the axe, followed by destructive bush fires.

A great change as regards water supply has been noted during late years. Many springs which previously were never known to fail have dried up, and the surface water passes away very quickly in the spring. Drouths during summer are much more prevalent since the forests disappeared.

The farmers have nearly altogether abandoned the growing of fall wheat in the higher portions of the county on account of its liability to be winter-killed for want of the protection of the timber. The advantage of planting either fall wheat or clover in a sheltered position is generally recognised. Windbreaks have been found beneficial, but as yet few have been planted. In one case a plantation of 4,800 young maples, occupying four acres, was made, with the result that only about three per cent. died, the remainder doing well and affording an appreciable protection to adjoining crops two years after setting out. Maple, elms, ash and basswood all do well as shade trees. For hedges or windbreaks cedar is easily grown and serves the purpose admirably.

A more stringent law against kindling fires in summer is needed to prevent destruction from this cause. It was suggested that municipalities should suitably encourage tree-planting by bonuses or otherwise, and that a portion of the time required for statute labor might be given to the work of tree-planting.

DUNDAS.

Probably about one-fifth of Dundas county is still covered with timber either of the original forest or second growth. Many of the farmers have retained a grove of maples as a sugar bush, and in some rocky places they have protected the young maple trees and have fine second growth groves. The other kinds of wood still to be found are soft ash, elm, soft maple, birch, tamarack, cedar, pine, balsam, bass, beech, rock elm, and a little spruce. The rock elm and basswood are being rapidly disposed of.

The land is mainly level and some slightly undulating; none of it can be fairly described as hilly. As a whole the soil is excellent for farming purposes, but there are a few small spots where the limestone rock comes to the surface, the most profitable use of which would be to keep them permanently in timber.

The water supply has been very seriously affected by the indiscriminate destruction of the forests. The result has been not only to dry up many small streams, but to threaten the larger ones with extinction. There has been a decided increase in floods, which, however, must be in some degree credited to the deepening of the shoals in the Nation river, and the opening out of the water-courses leading thereto, which draw off the surface water rapidly in the spring.

There have been very few windbreaks planted, but wherever it has been done the effect has been very satisfactory. In addition to affording shelter from the wind they provide a grateful shade from the heat of the summer sun and preserve coolness and moisture. The varieties mainly employed are hard and soft maple and evergreens. The soft maple is recommended as growing faster and thriving better than the others. This will probably be on low lands.

Fields of fall wheat and clover when protected from northerly winds by a belt of timber are not so likely to be winter-killed as those exposed to the wind and liable to be laid bare of snow and subjected to alternate freezing and thawing.

Much damage to the remaining timber has been caused by bush fires, and if a proper proportion of forest is to be preserved more care will have to be taken to prevent destruction from this cause. In the opinion of some residents much might be done to encourage replanting if the municipal councils could be induced to take advantage of the Provincial Government's offer of a bonus for trees planted along highways and boundary lines.

ELGIN.

It is estimated that about one-third of the county of Elgin is still wooded land. The leading kinds of timber now found within its limits are beech, maple, elm, and ash, which are widely distributed over every part of the county. There is also a good deal of oak, hickory, chestnut, whitewood and basswood, and cherry, sycamore, butternut and black walnut in smaller quantities. In the eastern portion of the county there is a large quantity of pine.

The land is for the most part rolling, though about the centre of the county there is a good deal of level land, and the regions bordering on the lake to the south and on the river to the north is in some portions quite hilly. Though generally well suited to the plow, there are portions to the east and extreme west which could be more profitably devoted to forestry than to farming.

A marked increase in freshets in the spring and fall seasons and less water in the streams during the summer months have been the result of deforestation.

In November last the river Thames, which forms the northern boundary of the county, rose 24 feet in as many hours. At one place there can be seen the remains of three bridges, besides the present structure, and each shows that it was constructed about six feet higher than its predecessor, the last being fully twenty feet higher than the one constructed about forty years ago.

The ground becomes dry much earlier in the year in consequence of the absence of forest protection. The benefits of the shelter afforded to fall wheat crops is universally admitted; the same fact has been observed in connection with the clover crop, though in a less degree. There is some difference of opinion among farmers as to the cause why these crops survive the winter better when sheltered by adjoining timber. Some claim that the forest is a direct protection to the plant, while others take the view that the only service it renders is in acting as a windbreak and preventing the snow from drifting.

A few windbreaks have been planted with good results. The trees principally employed are Norway spruce, pine and maple. Spruce are considered the best for the purpose, but the soft maple is a tree of quicker growth. There are a few rows of Lombardy poplars which make excellent windbreaks. Much destruction is caused by allowing cattle access to the bush as they eat away and break down the underbush and small trees.

ESSEX.

About one-fourth of this county, on a rough estimate, is still in timber, the principal kinds now to be found being black ash and soft maple. In some localities there are scrubby oaks, but all other merchantable timber has well nigh disappeared. The land is generally level and nearly all fit for farming purposes. Originally there was a good deal of marsh or waste land, but under the drainage system it has nearly all been brought under cultivation, and is well adapted either for agriculture or tree planting. Hitherto the planting of forest trees for windbreaks has practically been limited to the setting out of a few spruce or other ornamental trees about the houses and gardens.

As regards the experience of farmers as to the protection afforded crops by the shelter of adjacent forests, it has been noticed that a field of fall wheat grown alongside of a piece of woodland, especially when the shelter is on the west or north side or on both, shows in the spring-time the advantage of the protection received. It frequently happens that the portion of the crop sheltered by the timber survives in good condition while that occupying other portions of the same field were all winter-killed. The woods prevent the drifting of the snow by which the field would otherwise be left exposed to the full severity of the frost. If the farmers were to plant spruce trees as a substitute for fences it would not only improve the appearance of the farm, but act as a wind-break, and ensure a measure of protection to the crops. These trees can be set so closely together as to form a tight fence after a few years' growth, and in the meantime, if a close fence is required, a few wires can be run through them at small expense.

The principal climatic change noted in this locality is the lessening of the snow fall in volume during late years. The rains are not so regular as formerly, and as regards floods and drouths the seasons are very variable.

There is a disposition to favor Government encouragement to tree-planting in the form of a bonus to those who will plant a number of fast-growing kinds of trees each year. Another proposition is that it should be made obligatory on every farmer to lay out or maintain a portion of his farm as a wood-lot.

GLENGARRY.

Of this county probably about one-third is still under timber, the principal sorts being maple, birch, beech, basswood, rock elm, black elm, black ash, hemlock and some white pine. Cedar, tamarack, balsam and balm of Gilead are found in smaller quantities. There are some stretches of level land, but the general character of the surface is rolling. While the soil is generally good and suitable for agriculture there are some small stony areas which could more profitably be devoted to tree-planting.

As a result of deforestation the volume of water in the rivers and streams has been greatly reduced during the summer and fall. In many cases the smaller water-courses are completely dried up. In the spring the water is very high for a short season. Swamps and low-lying lands pour out into these streams in a week or two all the water which when covered with timber they formerly retained until midsummer.

Fall wheat and clover are not so extensively cultivated here as in the counties further west, these crops being regarded as uncertain owing to climatic conditions. The protection of the forest securing the more equal distribution of the snow fall has been found to be attended with favorable results. Within the last ten years some plantations and windbreaks have been set out, mostly on a small scale, and near the farm buildings. The kind of wood generally employed is the hard maple. These trees have so far thriven well, but the experiments are too recent to warrant drawing any decisive conclusions as to the result.

The general impression is that not much activity in replanting on a large scale can be expected among the farmers unless some inducement is held out to them by the Provincial Government or the municipalities to compensate them for the expense, either in the form of bonuses or exemptions from taxation.

HALTON.

Maple, beech, oak and elm are the principal constituents of the scanty remaining woodlands of Halton county, which only comprise some five per cent. of the whole area. There is also a little pine and cedar left. The general surface of this county is slightly undulating. The mountain range traverses it, but only a very small percentage of the area is suited for agricultural purposes. The heights and slopes of the mountain range could profitably be utilised for tree-planting. There has been a considerable increase of floods and drouths in consequence of the excessive clearance of the country, the water running away much more rapidly in spring-time than formerly, and the general flow of the streams at other times of the year being very much lessened.

Plantations either in mass or as windbreaks have only been made to a limited extent. But the experience of those who have made the trial has been so satisfactory, and the effects of the protection afforded so beneficial, that the farmers are becoming more alive to the advantages of the system, and it is probable that much greater improvements of this kind will be made in the near future. White pine has been found the best tree for the purpose of windbreaks, and Norway spruce has also answered very well. Willow has been tried, but has not answered so well. The protection of the forests has been a great benefit to grain and clover, and in fact to crops generally, not only in defending them from the effects of frost, but in retaining the moisture during the hot weather. Land situated near a forest or windbreak does not suffer in the summer time from the drying effect of the wind, as does that more exposed.

There is a growing feeling among the farmers in favor of the encouragement of tree-planting by government or municipal bonuses. A slight aid of this sort to partially compensate for the first cost of the undertaking would give a considerable impetus to this much needed improvement.

HASTINGS.

The characteristics of the front and rear portions of this county are widely different. The six front townships are nearly all good agricultural land, the soil being generally clay or light loam. About one-tenth of this section is still timbered with hardwood. The rear townships are hilly and rocky land, interspersed with small lakes. This section was largely timbered with pine, the most of which has been cut or swept by bush fires, leaving large areas of broken burned-over country entirely unavailable for farming purposes, and covered in parts with a second growth of poplar, white birch and other trees. The original forest yet remaining is mainly hemlock, spruce, balsam and hard woods. There are portions here and there adapted for cultivation.

A marked increase in the volume of the spring floods and a corresponding diminution in the summer flow of the Moira River which forms the principal outlet. During the last thirty-two years bridges over the river have been frequently carried away, and in the course of successive re-buildings and repairs it has been found necessary to raise them from four to five feet above their former level, notwithstanding which the upper bridge was seriously endangered by ice carried down by the spring flood of 1891. In ordinary summers during the last fifteen years the volume of the Moira has been reduced to that of an average spring creek, and during the latter portion of the summer of the same year the whole of its current would have passed through an eight-inch pipe with a head pressure of ten feet.

There has been no noticeable planting of windbreaks beyond the setting out of a few ornamental trees. It is the general experience of farmers here as elsewhere, that where fall wheat and clover fields are protected by forest to the west and north, the results are beneficial and there is little danger of destruction or injury by frost. The suggestion that each farmer should be compelled to keep a certain proportion of his land in forest meets with approval in some quarters.

So far as the northern portion of the county is concerned, the most pressing need is more stringent regulations as to starting fires. Some of the devastating fires that have swept the bush or partially cleared regions are attributed to the carelessness of miners, berry-pickers and hunters, who, it is thought, would be more under control of the Government fire-rangers if they were compelled to take out licenses before entering Crown lands.

In the settled parts much destruction is caused by pasturing cattle in the bush, which ruins the young trees.

HURON.

From eight to ten per cent. of the total area of Huron is wooded land but the timber throughout has been much culled for lumber and fuel, so that there is little, if any of the forest left in its original condition. About five per cent of the land is hilly, from ten to fifteen per cent. level or nearly so with some swampy flats, and the remainder rolling. The greater part of the soil is well suited for farming, about four-fifths of it being a clay loam with limestone and gravel sub-soil; there is but very little rocky land. The varieties of wood yet remaining are principally soft elm, black ash, beech and maple. There is very little pine left, and some hemlock of an inferior description. The prevalence of soft elm is due to the fact that the most of the land left uncleared is low and swampy.

Since the wholesale clearance of the land drouths have been more frequent, and within the last few years there have been two or three severe floods, in particular one in August, 1887, which caused the streams to rise considerably above the usual height of the spring freshets. The want of rain in May and June has frequently caused a serious shortage in the hay crop and injured other crops.

Observation has shown that fall wheat and clover have been materially benefited by the neighborhood of forests. The young plants protected by the shelter of the woods are not so liable to be lifted out of the ground by the action of alternate frost and sunshine in the spring, as those growing in more exposed situations.

A few windbreaks have been planted, and in some cases a belt of timber has been left in clearing to answer the same purpose. This has been mostly done in the immediate neighborhood of farm buildings and orchards, and the effect has been beneficial. The trees usually left as windbreaks are maple, elm and basswood, but wherever evergreens such as Norway spruce and Canadian spruce have been planted they have thriven well, and are regarded as the best, being more efficient as winter wind-breaks than deciduous trees. The Canada fir balsam has not been found equal to the spruce, as the lower limbs die off in a few years leaving naked trunks. This is particularly the case where the trees are planted in clumps or thickets. Maples nearly always do well on good dry land.

The corporations of some towns and villages offer a bonus for tree-planting, and similar action by the Local Government in regard to rural districts would stimulate this much

needed movement. Another proposal which meets with approval is that a certain proportion of timber land on each farm, say from ten to twenty acres, should be exempt from taxation. In many cases the taxation of uncleared lands has forced the owners to clear them off, to defray the expense of holding them.

As an instance of what might be done could the farmers be aroused to the necessity of replacing the timber and convinced of the profitableness of tree-culture, it may be mentioned that a farmer some five years ago planted one bushel of walnuts. The result surpassed his expectations, and he has now about 1,200 young trees from eight to ten feet high, which have flourished without any manuring or cultivation. Much injury is done to the remaining patches of forest by cattle, as the farmers do not generally realise the necessity of excluding them from the bush in order to allow the saplings to grow up and replace the heavy timber when removed.

KENT.

The timber land of Kent is estimated at about twenty-five per cent. of the total area, but a good deal of the land that is not under cultivation has been denuded of the timber. The leading kinds of timber still extant are water elm, black ash, basswood, hickory, beech and maple. Oak and walnut were once plentiful, but no supplies of either of any consequence remain. These valuable woods were nearly all exported at a time when they only commanded a sufficient price to pay for the labor of cutting and marketing them. The recklessness and improvident disregard for the future with which these invaluable forest resources were exploited can now be realised when it is considered that oak that sold fifteen or twenty years ago at \$4.50 per thousand feet could now be marketed at \$25 per thousand, and walnut which then only brought \$14 per thousand feet would to-day command \$100.

The land throughout the county is very level, and available for either agriculture or tree planting, there being no localities specially adapted for the raising of timber by reason of their unsuitableness for cultivation. There has been little done in the way of tree-planting, the only improvements of this kind being the planting of rows of shade trees for ornamental effect rather than with a view to crop protection or the future supply of timber.

Owing, no doubt, to the flat character of the country the effect of deforestation in reducing the volume of the streams and inducing floods and drouths has not been so marked as in other places. While, as before remarked, there is no particular locality in the country which from its unfitness for agriculture, seems more specially marked out as an area for planting for profit, there is urgent need for encouraging the planting of windbreaks and belts of timber by the farmers.

LAMBTON.

The wooded portion of this county is about one-fourth of its entire area. The surface of the land is principally level, but slightly rolling in some parts, and rather hilly towards the eastern boundary. It is nearly all cultivable. There is some sandy land on the lake shore, chiefly in Sarnia and Bosanquet, which was originally occupied by forests of white and black oak and, in places, good groves of white pine. Most of this timber has been cut down. This sandy area is of little or no use for any other purpose than tree-planting, but it would be difficult to insure the growth of trees at the outset. Probably the best tree for the purpose would be the yellow locust, to be raised from seed.

The principal kinds of native timber now to be found in the county are swamp elm, black ash, white ash, hard and soft maple, hickory, basswood, oak and beech. Cotton wood has sprung up on old clearings as second growth. But few windbreaks have been planted, and those on a small scale. Among trees introduced for shade or ornamental purposes are Norway maple, golden willow, Lombardy and silver poplar, European alder, Norway spruce, Austrian pine, Scotch fir and larch, all of which seem to endure the vigor of the climate well and grow vigorously. The Manitoba maple is a rapid grower and easily raised from seed.

The principal effect noticed in consequence of the clearing of the land has been the increased severity of drouth during the summer. Floods rarely prevail to such an extent as to do much damage, but the water drains away more rapidly in spring than formerly, and as a consequence the streams are somewhat reduced in volume.

The proportion of wooded to cleared land being still comparatively large the scarcity of wood is not felt as it is in some other counties, and consequently but little attention has been paid by the farmers to the subject of re-planting. The wood lots are as a rule much neglected by the farmers, the best trees being taken for fuel, etc., and nothing done to replace them. Much injury is caused by pasturing cattle in the bush. If care were taken to keep out cattle a good growth of young timber would spring up spontaneously, but more good could be effected by replanting with quick-growing and valuable timber, such as black walnut, hickory, ash, etc. If the provision of the law allowing land owners to plant trees along the roads bounding their farms were taken advantage of, and black walnut or other timber set out or sown, an appreciable addition would be made to the value of each farm.

LENNOX.

The process of denuding the soil has probably been carried as far in this county as any where in Ontario, only about five per cent. of the total area remaining in timber. The chief kinds of wood now to be found are maple, beech, cedar, balsam, elm and tamarack. The surface as a rule is rolling, and the soil varies from light limestone to sandy loam, rich vegetable mould and stiff clay. In the main it is good agricultural land, though there are portions better adapted to tree-planting.

The water supply has been materially affected by the destruction of the forest. The rivers sink much lower than formerly in the summer, and the small streams dry up altogether. Observations of old residents, extending over the last forty or forty-five years show a marked increase of floods and drouths, more particularly the latter.

Where windbreaks have been planted the effects have been good. One farmer, Mr. Allen Pringle, has planted during the past few years seven or eight hundred basswood and one hundred maple. He suggests the encouragement of planting by the Provincial government and municipalities, and also that as desirable trees for plantations and windbreaks are not within convenient reach of the people in many localities, the agricultural colleges and experimental farms should be devoted much more largely to the growth of such trees. Thus they would become the sources of supply at light expense to those willing to plant.

LINCOLN.

As is the case in most of the frontier counties, the proportion of timbered land yet remaining is very small, probably not more than five per cent. The general quality of the soil is good, ranging from light sand to black loam and heavy clay, the land being well adapted for fruit growing and farming. The county is crossed from east to west by the escarpment known as the mountain, from which descend numerous streams which find their outlet in Lake Ontario, and cut deep gorges in the hillside and rising ground, otherwise the land is level. The hills and gorges are better adapted to forestry purposes than to agriculture, while the mountain bluff facing the north is entirely unsuited for any form of tillage, being rocky, so that forestry is the only profitable use to which it is adapted. The timber yet remaining in the county is chestnut, beech, basswood, maple, oak, pine, white elm, black and white ash and whitewood.

The effect of the clearing of the timber has been very decided. Streams which formerly ran the year round almost entirely dry up during the summer, with the exception of the ponds which have been formed near the lake. There are frequent floods in the spring-time, and drouths are at times severe. The extensive planting of fruit trees may have had a beneficial effect in mitigating these evils. There have been so few plantations of forest trees or windbreaks that it is difficult to obtain data for an opinion as to the effect upon agriculture. Where wind breaks have been planted spruce and willow have been put in, the former being usually preferred.

Where fall wheat and clover crops have had the protection of timber remaining, in the immediate neighborhood the result has been beneficial. Among the suggestions received from farmers and others interested in the restoration of the forest in suitable localities, is the exemption from taxation of forest land under such conditions as might be thought advisable to prevent any abuse of the privilege and ensure good faith.

MIDDLESEX.

The proportion of land remaining under timber in Middlesex is about fifteen per cent. The soil was originally heavily wooded with numerous varieties of trees principally hardwood. Very little pine, cedar or hemlock has been left, the kinds remaining being chiefly maple, beech, oak, elm and ash. The surface of the land is largely rolling, with a small proportion hilly or rocky to such a degree that it is unfit for profitable cultivation. The level and undulating portions are excellent soil, being chiefly clay loam and in some sections heavy clay and sandy loam. The only portions better suited to forestry than agriculture are the comparatively small rocky and hilly areas.

The effect of the clearance of the country has not been so noticeable as in most other localities. The small streams dry up earlier in the summer, but this is attributed partly to the drainage system by which a large volume of surface swamp water is drained away rapidly in the spring. Where the land has been well drained it is capable of retaining a larger quantity of moisture than formerly in the summer season, which perhaps to some extent prevents the drouths resulting from over clearance being so severely felt as would otherwise be the case.

The protection of forests and windbreaks has been found favorable to fall wheat and clover. These crops naturally suffer less from the frost here than in most other localities on account of the character of the soil and the conformation of the land. It is the low clay lands, which if unprotected by trees, are principally subject to this danger.

Plantations of trees covering many acres are rare, but many windbreaks have been planted on a small scale. Most farmers and owners of cultivated land have planted trees to some extent as a protection to the buildings, gardens and orchards. Trees have also been set out along the highways for shelter and ornament. The effect has been greatly to improve the appearance of the country and considerably to increase the financial value of the homesteads thus improved.

A great variety of trees have been tried, both native and foreign. All kinds that are hardy enough to stand the winter do well if sufficient care is exercised in the planting. The most popular varieties are maple, ash, elm, pine, cedar, Norway spruce and Scotch and Austrian pine, all of which flourish successfully. A few walnut trees have been planted, but too recently to warrant any conclusions as to the success of the experiment.

MUSKOKA.

Probably about three-fourths of the district of Muskoka is still uncleared land though lumbering operations have been carried on extensively throughout this area. The country is decidedly hilly and broken, and there are many rocky ridges and swamps, rendering a great proportion of it altogether unfit for farming and adapted for permanent timber reserves. Nearly all the pine of a marketable character has been cut, and the hemlock is rapidly being removed. The predominant varieties of timber which remain are ash, oak, basswood, maple, birch, cedar, tamarack, spruce and balsam. The timber has been cut indiscriminately; many rocky tracts, which are utterly useless for any other purpose than timber growing, have been completely stripped, or after being partially cleared, devastated by fire.

The effect of the cutting down of the woods upon the water supply has not been so marked as in the more settled parts of the country, but is nevertheless very apparent. Wells and creeks dry up much sooner in the season than formerly, and snow does not fall with the same regularity as it once did.

Little or no fall wheat is grown in this district, the climate not being favourable to it. Clover has been found to flourish better when sheltered by the woods than when exposed to the winter winds.

No plantations or wind-breaks as far as known have been planted, owing to the comparatively recent settlement of the country. Some trees have been set out for ornament and shade; these are principally balsams, which thrive well.

The great danger to the remaining forest is from bush fires, which are caused by the carelessness of lumbermen, campers-out, settlers and others, and greatly promoted by the vast quantities of tree-tops and refuse left lying in the woods after lumbering operations. Of late large quantities of hemlock have been cut for the sake of the bark alone, the timber being left to rot on the ground. There is great need of stricter regulations to check this waste and prevent the danger attending it. Settlers ought to be prevented from entering upon and clearing land which is unfit for cultivation and ought to be left in timber.

NORFOLK.

About twenty per cent. of this county is timbered, the kinds which predominate being elm, black and white ash, chestnut, maple, birch, and second growth pine. The surface as a general rule is undulating, but portions along the lake shore are hilly. The soil is generally good and well suited for tillage, but some parts are more adapted for tree-planting. As a result of the extensive clearing of the country many streams now dry up completely during midsummer. Most of the larger streams upon which grist mills are situated become so low as seriously to interfere with milling operations. An increase in floods has also been observed owing to the rapid flowing off of the water from the melting snow in spring time. The climate has undergone a decided change for the worse—the rainfall in the summer has been lessened and severe drouths frequently prevail.

Forest and wind-breaks have been found highly advantageous to the fall wheat and clover crops. Deprived of this shelter the snow is frequently drifted off, leaving the ground exposed, in which case the plants are liable to be winter-killed.

No plantations on a large scale have been made. The farmers generally have put in trees for ornament and shade along the roadside, using principally hard and soft maple. Such wind-breaks as have been planted are for the most part around the farm buildings and orchards, spruce, cedar and willow being the kinds generally selected. The result has been highly encouraging. Several orchards protected by a wind-break of spruce or cedar yielded heavy crops of fruit last fall, where other orchards, unprotected, were almost an entire failure under precisely similar conditions as to soil, culture, etc. Evergreens such as the Norway spruce, cedar, or some of the pine species have been found to afford better protection than the deciduous trees.

The principle obstacle in the way of forest preservation and re-planting is the shortsightedness of the farmers as a class, who cannot be convinced that it is in their interest to maintain a proper proportion of wooded land. In many cases their farms have been entirely stripped of trees, and it has become necessary for them to purchase wood-lots of from ten to twenty-five acres to supply themselves with fuel, often at a distance of five or ten miles from the farm. Even under these circumstances many of them cannot be convinced that re-planting is necessary, because they do not see any profit in it for the near future. The opportunities offered by the Ontario Tree Planting Act have not in any instance been taken advantage of. The suggestion was made that this Act should be amended by adding evergreens to the list, as being more valuable for wind-breaks than the varieties specified in the Act; also that the New York Stock Law which prohibits the running at large of cattle, should be adopted in this province as a protection to trees planted on the highways.

NORTHUMBERLAND.

Like most frontier counties Northumberland has been almost denuded of its timber. The proportion of wooded land remaining is only about five per cent. of the whole. The remaining forests are principally hard wood with some cedar and a small quantity of pine. The soil is variable, its principal constituents being clay, clay-loam and sandy-loam. There is but little stony or hilly land, the surface being generally rolling and well suited for agriculture. The steep hills and ravines and the land which is too rocky for the plow could be planted with trees to good advantage.

The destruction of the forests has had the effect of lessening very considerably the volume of the rivers and streams. Many watercourses are now dry for nearly half the year, and there has been a great increase of spring floods. Drouths have not been so prevalent here as in some other parts of the country.

Fall wheat has become a very uncertain crop, and owing to repeated failures has been much less cultivated of late. The clover crop, though hardier, has also suffered from exposure caused by the absence of forest protection. It is often winter-killed and suffers from spring and summer drouths.

There has been little done in tree-planting, excepting in the immediate neighbourhood of buildings and gardens. Where this has been done the effect has been to greatly improve the appearance and increase the value of the farm. The evil of cattle running at large and pasturing in the wood-lots is prevalent, and much injury is done to young trees in this way.

ONTARIO.

Ontario was pretty thoroughly examined by means of drives through the country, in which Mr. Farewell, the energetic County-Crown Attorney of the district, gave valuable assistance. Much useful information was also gained from J. D. Howden, Esq., of Whitby, who had occasion lately to examine all the lands, wooded and otherwise, of the county of Ontario. Generally speaking, there appears to be scarcely five per cent. of wooded land left in the county, and not much of this appears to be good beech and maple. The hickory tree, that is the bitter nut, is yet found here, but no one I met knew of the existence of any sweet ones. The walnut did formerly grow in these woods, but only a few specimens were now observed, and these are planted in the open, and therefore run to branches more than to clear timber. Many valuable pine trees formerly grew here, but now there appears to be very few left. In the northern part of the county the swamps occur more frequently than in the south, and occupy sometimes from one-third to one-fourth of the land. These swamp lands are wooded with cedar, balsam and tamarack, comparatively of no merchantable value at the present time.

It was noticed that east of Oshawa, where rivers formerly existed, which gave power to a score of manufacturing industries, and where water ten feet deep allowed the construction of many vessels, there exist now but paltry streams, sometimes but a couple of feet deep, sometimes but six inches in depth.

Where farmers possessed shelter, they invariably gave their crop of fall wheat the benefit.

OXFORD.

The county of Oxford contains about five hundred thousand acres of land, of which about one hundred thousand are nominally in forest. Not more than two-thirds of this will be beech and maple, the rest being composed of various woods such as oak, ash (both black and white), with some of the nut trees, such as hickory, chestnut and walnut. There was formerly much valuable pine here, but most of this is long cleared.

The surface is generally level, and much of it very rich land. There are many rows of trees planted, both evergreen and deciduous. For instance, some fine specimens of both are to be found on the old Vansittart estate. No plantations set in close order for timber purposes were observed. The town of Woodstock possesses many rows of beautiful shade trees, principally maples. They need, however, as is indeed usual, far more careful trimming and thinning than they receive.

At a meeting of a committee of the County Council, where the subject was discussed, opinions were expressed by leading men that lines of evergreens would be the most valuable for sheltering purposes, as giving protection in winter when most needed. Moreover, some gentlemen considered that in that part of the country they were more easily handled, and succeeded even better than the maples. Besides, it was noticed that they could be planted at a time of year when the farmer has more leisure than in spring and fall, when other work presses on his attention. The opinion was general that a proper proportion of forest should by all means be preserved in the country.

PARRY SOUND.

The land in this district is much broken. There are many low hills and hollows and much rock. The soil varies from heavy clay to light sand, and in some places all varieties are found within the limits of a single farm. Owing to these natural characteristics there are considerable areas which are not adapted for agriculture, and which, if they are to be utilised so as to realise a continuous profit, must be kept in forest or restored to their natural wooded condition. The rocky flats and hills, many of which have been cleared or burned over, are absolutely valueless for any other purpose than tree-growing.

The proportion of land now in timber, properly speaking, not counting the scrubby second-growth that is coming up over the land devastated by forest fires, is about sixty per cent. of the whole. The chief varieties of timber extant are maple, beech, hemlock, cedar, tamarack, spruce, red oak, pine and birch. It is noted that as a consequence of the destruction of timber, small creeks dry up earlier in the season than formerly. The Georgian Bay has sunk some four feet within the last eight years, which some are disposed to attribute to the disappearance of timber about the head waters of the streams which debouch into it.

The destruction of the forest and its attendant evils are due fully as much to forest fires as to clearing or lumbering operations. It is suggested that in order to preserve the forest in those parts where the nature of the soil renders farming unprofitable, all lots having over thirty per cent. of rock should be withdrawn from sale and retained as permanent forest land, and that in sale of any timber on these lots it should be stipulated that all tree-tops be removed and burned so as to prevent the danger of bush-fires.

PERTH.

This is a thickly-settled county, nearly all of the land being available for agricultural purposes, and consequently the wooded area has been rapidly diminished, until at present the area in timber is only some 15 to 20 per cent. of the whole. The surface is pretty well divided between level and rolling land, the townships of Ellice, Logan, South Easthope and Elma being for the most part level. In North Easthope, Wallace, Blanshard and Mornington the land is principally undulating. Portions of Hibbert township are hilly, and the other townships of Downie and Fullarton partly level and partly rolling country. It is doubtful whether any portions of this country could be regarded as better adapted for tree-planting on a large scale than for agriculture, considered from the standpoint of individual profit. The principal kinds of timber remaining in the uncleared portions of the county are beech, maple, black ash and elm. Basswood, pine, hemlock, cedar and birch are found in smaller proportions, and the necessities of the farmers for firewood and fencing cause steady inroads upon the woods which yet remain. The effect of settlement upon the streams has been marked, the volume of water being greatly lessened, excepting during the spring freshets and after heavy rainfall. Some are disposed to attribute this to drainage operations, which may perhaps be a contributing cause, though there is no doubt that the principal factor in this change is the destruction of so large a proportion of the timber about the streams. The farmers as a rule appear slow to realise the need of forest preservation or replanting as a means of averting the evil of alternate floods and drouths and providing for the needs of the near future.

PETERBOROUGH.

The land of this county is principally rolling, and in some places hilly, and the soil clay or clay loam, and excellent for cultivation. The proportion of uncleared land is small—probably not more than five per cent. in those sections of the county comprising the more desirable farming land, but somewhat larger where the soil is not so fertile. The native forest trees which still remain are chiefly beech, maple, elm, ash, balsam, spruce and hemlock.

Not much attention has been so far given to the preservation of the remaining tracts of forest or to replanting. What has been done is mainly in the way of planting trees for ornament and shade about the buildings, or bordering on the roads. The kind of trees most in favor are the maple, spruce and elm. The more intelligent class of farmers are beginning to take an interest in the subject, and tree-planting is much more common than a few years ago. The opinion was expressed that further encouragement in the form of premiums or exemptions from taxation upon plantations or land permanently kept in timber would considerably stimulate tree-planting, as it is difficult to induce farmers to lay out money and labor without some prospect of a more immediate return than that promised by forestry, considered from a purely business standpoint.

The general opinion is that fall wheat and clover are benefited in no small degree by the protection afforded by woods, which act as a shield against the wind.

The destruction of the forests has been followed, as in other places, by the drying up of many small streams and springs in the hot weather, and the volume of water in the rivers has been considerably lowered. No floods of any consequence have occurred, but the farmers have suffered much from protracted drouths.

There are many thousands of acres of waste land in the northern portion of this county, which were formerly partially covered with timber. This has been cut, and the county swept with bush fires, which in many places have left only the bare rock. A second growth of poplar, birch and other woods is springing up. These waste lands, which are entirely unfit for agricultural uses, ought to be kept permanently in timber.

PRESCOTT.

About one-third of the County of Prescott, at a rough estimate, is still timbered land. There is a good deal of maple standing, the sugar bush having in most cases been preserved. The other leading varieties of timber which remain are elm, beech, birch, basswood, ash, cedar, hemlock, spruce, tamarack and balsam. The pine that still exists is principally second growth, and there is little that is marketable. The land is pretty equally divided between level and rolling ground, and there is none of a very hilly or broken character. Some portions are better suited for tree-planting than for agriculture.

A lessening in volume of the streams has been noticed as taking place simultaneously with the clearing of the country, but this has been intensified by the drainage system, which runs off the surface water early in the spring.

Fall wheat does not grow successfully in this county. The clover crop is found to thrive better under protection from the wind, so that the snow does not drift and leave it exposed to the action of the frost.

Very little has been done in the way of setting out plantations or wind-breaks. Where the latter have been planted evergreens have been found to answer best. The black walnut, when planted, has been found to thrive well. Mr. J. C. Marston planted about 150, which are probably the only trees of this kind in the county, and reports that they are fully as hardy as the butternut or maple. The farmers, as a class, are slow to realise the need of forest preservation, and the wood-lots are usually neglected and exposed to the devastations of cattle.

 RENFREW.

The portion of the county still in timber is probably one-third of the whole, and perhaps an equally large extent of uncleared land has been swept by fire, destroying the timber. The most plentiful kinds of trees now found are white and red pine, white spruce, maple, tamarack, birch, beech, red and white oak, ash and elm. The surface of the country is generally rolling, with level flats interspersed, and broken by the Opeongo hills. The general quality of the soil is good, but there are some stretches of light, sandy ground which could profitably be given over to tree-culture, as farming there is barely remunerative.

The flow of water in the streams at all times of the year, excepting a short period in the spring, has been very materially decreased of late years. So much is this the case that streams which were formerly regarded as permanent sources of water power are now valueless for that purpose.

The shelter afforded by forests and windbreaks has been observed to be favorable for all kinds of crops. Not many windbreaks have been planted, but the beneficial effects of those which are in existence have been very apparent. A considerable variety of trees have been tried for this purpose, including spruce, balsam, poplar, pine, maple, birch and willow. Experience has shown that pines flourish best when raised from the seed and set out, if transplanted close together, so that they protect each other.

Among the suggestions received from those familiar with local conditions and needs in this county as to the best means of preserving and restoring the woodland, were the following: That societies for the purpose should be formed, similar in plan and working to agricultural associations, and premiums offered for the largest and best plots and belts of young trees at different stages on patented lands. That the Government should prevent the cutting on Crown Lands of timber of a smaller size than twelve inches in diameter at the butt end. When all timber over that size has been cut the Government agents should be required to see that no more cutting is done, and the fire guardians instructed to take every means for the prevention of fires. Before lots in new townships are thrown open for settlement they should be examined to ascertain whether they are fit for cultivation or not. If found unsuitable for farming, they should be withdrawn from settlement and allowed to remain in timber. Every encouragement should be given for the removal of the dead timber, which from its liability to take fire easily, is always a source of danger to the growing timber.

SIMCOE.

The land of this county is in the main level, with some undulating ground and a smaller proportion which is too hilly for successful cultivation. It is mostly choice agricultural soil, the only portion which would be better adapted for tree-planting as a directly profitable investment being the hilly and rocky areas and swamp lands. The process of clearing has been carried on recklessly and indiscriminately, many parts which owing to their unsuitableness for farming should have been left in timber having been wholly or partially denuded. The proportion of timbered land remaining is estimated at from eight to ten per cent., and the process of destruction is still going forward. Beech, maple, hemlock, ash and tamarack are the chief kinds of timber yet extant.

The volume of water in the streams has much decreased since the land was cleared and some of the small creeks have altogether dried up. Floods are frequent in the springtime and severe drouths often cause considerable loss and inconvenience to the farmers in summer.

Little, if anything, has been done in the planting of windbreaks, though the usefulness of a belt of trees as a protection to crops from the wind, especially in winter is generally admitted.

VICTORIA.

In the southern portion of this county the land has been much more thoroughly cleared than in the northern section, being much better soil. In the Townships of Mariposa, Ops, Emily, Eldon, Fenelon and Verulam there is not more than ten per cent. of forest land, while in the remainder of the county to the north the proportion of uncleared land is estimated at about sixty per cent., though considerable areas of this have been overrun by brush fires. The principal kinds of timber remaining in the southern part are cedar, tamarack and spruce in the swamps, and some hardwood which is rapidly diminishing. The pine is nearly all gone. The leading varieties in the northern sections are maple, hemlock and cedar.

The land in the front townships is generally level or with a slight southern incline. The northern portion is more rolling with hills and ravines in places. Some portions would be better suited for tree-planting than anything else, especially the ravines and hillsides and localities which are too rocky or stoney for profitable cultivation, of which there are not a few.

Floods have undoubtedly been more frequent since the country has been so largely cleared. The effects of continued dry weather are more severely felt than formerly, owing to the greater evaporation from the soil when exposed to the heat of the sun and to the influence of drying winds.

Forty or fifty years ago the area of cleared land was so small in proportion that all crops were practically surrounded by woods. The snow then covered the ground evenly and generally remained until after the middle of April or until all danger from spring frost was passed. Latterly, owing to the uncertainty of the crop when deprived of this protection, there has been but little fall wheat sown. Belts of trees along the roadsides, line fences or in other appropriate situations are much needed as a protection to the fields. In some places wind-breaks have been planted, but as yet the trees are small and it is too early to speak as to actual results. Maples have been found to flourish well, and evergreens also, if planted at the right time.

The farmers are as a rule indisposed to undertake the trouble and expense of preserving woodlands or replanting unless assured of some pecuniary benefit in the near future. The exemption of forest lands and plantations from taxation to the extent of 25 acres on each 100 acres would, it is thought, be a considerable incentive in this direction.

WATERLOO.

The timbered area of the County of Waterloo is estimated at not over 15 per cent of its whole extent. The land is principally rolling with a few hills, and nearly all well suited for tillage, being principally loam with some smaller areas of sand. The woods which are left are mainly beech, maple, black ash and cedar, with some elm. They are rapidly diminishing to supply the demand for fuel and timber for manufacturing purposes. The usual results have followed the indiscriminate clearings that have been made, viz., floods in the springtime and after heavy rainfalls, and the drying up of the creeks during the heat of the summer. The absence of forest trees has also left the crops more exposed to the effects of drouth.

By plantations or windbreaks so far little has been done to counteract the effects of over-clearance. A few windbreaks have been made, and the farmers who have adopted this means of protecting their crops from the sweep of the winter winds are exceedingly well satisfied with the result. It is probable that as the value of this improvement becomes better understood many others will follow their example. The trees used for this purpose have been principally hard and soft maples.

Testimony is practically unanimous as to the advantage afforded to the fall wheat and clover crops by the protection of trees, especially if the latter are situated on the west and north sides of the field. A farmer speaking from experience is of opinion that

the planting of black walnut trees would be a paying investment. He has at present such a plantation twenty-eight years old. The exemption of bush lands and plantations from taxation are recommended as measures which would induce the farmers to take an interest in restoring the due proportion of forest.

WELLAND.

At an outside estimate fifteen per cent. of the area of Welland is yet wooded. The principal species of trees now growing within its limits are beech, maple, ash, elm, oak, including pine oak and chestnut oak, and chestnut. Nearly all the land is available for agriculture. It is as a rule level, but there is an area of rolling sandy land in Pelham township, and large marshy tracts in Wainfleet and Humberstone, partly drained. This section is not valuable for farming purposes, and might be more profitably planted with cedar or soft woods.

Owing to the conformation of the country it is not liable to floods, but an increase of severe and protracted drouths has been noticed since the removal of the timber. Wind-breaks and forests have been found advantageous as a protection to crops. Northerly winds are not so injurious here as in other parts, and protection is principally needed against winds from the south-west. In the vicinity of Niagara Falls single rows of Norway spruce have been largely planted, and have proved effective as wind-breaks. In many places maples have been set out along the roads. Norway spruce, European larch, arbor vitæ and Scotch pine are considered the best kinds for wind-breaks.

Wood lots from which the cattle are excluded maintain their growth of trees unless too freely enlled. On the steep hills and other places where the soil is not favorable for tillage, chestnut plantations would be a profitable investment, the nuts and timber being both marketable. When the trees are cut the stumps usually send up shoots which, when they attain sufficient thickness, can be cut for posts. As there is likely to be a considerable demand for posts, such plantations would be a profitable source of revenue. The rapidly growing kinds of cherries could also be used as wind-breaks.

WELLINGTON.

Only a very small proportion of the land of Wellington is still timbered. Some farms are entirely stripped of wood, and fuel has to be procured from a distance. What remains of the original forest is gradually diminishing, except in the swampy portions, where there is a steady growth of underbush. Nearly all the commoner varieties of timber are represented, but the proportion of soft wood is relatively on the increase. The country is generally rolling, and the soil varies from clay to sand, being generally good agricultural land, but there are a number of small tracts of little value to the farmer, which might be advantageously utilised for timber growing.

As regards the effect of the destruction of the woods on the water supply, the seasons have been so variable of late, that it is difficult to draw any definite conclusions. The water undoubtedly runs away faster in the spring than formerly, but owing to the removal of obstructions in the streams, does not necessarily rise higher. The volume of the current in rivers and streams, through the summer, is much smaller and of less value for manufacturing purposes.

Fall wheat has latterly become a very uncertain crop, especially when sown late. There is no noticeable difference in the clover crop which does well on suitable soils.

No plantations worth mentioning have been made, but on quite a number of farms rows of trees have been set out on the roadside. These are generally maples. The hard maple does well where the soil is sufficiently dry, but is of slow growth, and the effect on crops is not discernible as yet. Soft maple, ash, and the softer woods, do better on a low, moist soil. There is urgent need for the preservation of what timber exists, by careful fencing, so as to permit the growth of young trees, and planting where it is necessary to replace the timber removed. Municipal encouragement to plant on roadsides and on waste lands is needed, to induce the farmers to actively interest themselves in the matter.

WENTWORTH.

In this county the proportion of timbered land to the total area is about one fifth. This is owing to the existence of a large swamp in the township of Beverly. In most of the other townships the proportion of wood to cleared land is much smaller than the general average. In the swamp lands, tamarack, spruce, balsam, cedar, birch and elm prevail. Elsewhere oak, elm, pine, maple, beech and chestnut are found. The surface and composition of the soil varies considerably in different localities. The conformation of the land is generally rolling. Portions of Beverly, West Flamboro' and Ancaster townships, are hilly and stony, so that cultivation is difficult, and would be more profitably devoted to forestry than to farming.

As a consequence of extensive and indiscriminate clearing, the streams have decreased materially in volume, and some have entirely dried up. The effect has been intensified by drainage operations, which draw the surface water off rapidly in the spring.

Numerous windbreaks have been planted, and the expectations formed of their utility as a protection to the fields have been fully justified by the results. Of the trees generally used, the balsam has been found to answer best. The pine is regarded as even superior as a protection, but is difficult to grow unless planted from seed. It is found that grain grown under the shelter of timber flourishes better and yields more largely than where this is lacking and the crop is more exposed to the wind.

The equal taxation of timbered land and that in immediate profitable use for farming, is regarded as one great cause of indiscriminate clearing. The farmer or land-owner holding a wooded lot and paying annual taxes on it, is often practically forced to cut and sell the timber in order to prevent its being too heavy a burden to carry. It is suggested that if a discrimination were made, and the taxes considerably lowered on timbered land, or even abolished altogether for a limited area, there would be a much greater disposition to retain land in timber than at present exists.

 REFORESTATION IN FRANCE.

There is probably no country where the destruction of the woods has been attended with more serious and obviously direct consequences than France, or where the action taken to remedy the evil has been more strikingly successful. This is owing to the conformation of the land in the region of the high Alps and other mountainous parts, where, of course, the elevation of the ground renders the danger of floods much greater than in a comparatively level country. In a land destitute of high hills, and where the soil is sufficiently porous to absorb and retain much of the rainfall, the results of deforestation, though in the end disastrous, are gradual. In mountainous regions they are catastrophic, and cause and effect are more directly apparent than in the slower climatic changes wrought in a level country.

Hence reforestation has for many years been an urgent and practical question in France as a means of arresting the devastation wrought by mountain torrents, and much attention has been devoted to the subject by scientists. Those conclusions, based upon lengthened observation and experience, are of great value in dealing with similar conditions elsewhere. A prominent feature of extensive regions in the high Alps is the indentation of the mountain slopes by ravines, of greater or less depth, created by the action of floods. These are known as torrents, in the formation of which a great deal of valuable land has been undermined and swept away, while the once-fertile plains beneath have been covered with the detritus. The only efficacious means of dealing with this destructive process has been found to be the replanting with timber the denuded lands, seconded in some cases by the formation of a heavy turf upon the ground adjacent to the water-courses.

Surell, one of the ablest French authorities on the subject, gives a graphic picture of the consequences of deforestation in the valley of the Dévolery, which affords an idea of the extent of the evil with which the government undertook to grapple :

"The Dévolery forms to the west of the Department of the High Alps an elongated valley, divided into two parts by a little *col*, and circumscribed by elevated mountain chains. It is entered by five passages, which are gorges or *cols*, which the horrors of the locality make impracticable for passage during a part of the winter. The mountains are bare—eaten up by the flocks and by the sun—they are without shade and without verdure. The bases of the mountains are almost deserts, having been ruined by the deposit of material dejected from ravines. The aspect of this miserable country is oppressive to the soul. One would say of it, "It is smitten with death." The pale and uniform color of the soil, the silence which weighs on the fields, the hideous spectacle of these mountains flayed by the waters and falling into disintegration, and everything about them announces a miserably ruined decrepitated land, which does not appear even to struggle against or resist, or resent its destruction. The unchanging serenity of the sky, which anywhere else would be a trait of beauty, adds here to the melancholy sadness of the country."

The writer goes on to show that every indication points to the country having been formerly wooded. Buried trunks of trees are exhumed from the peat. Pieces of enormous timber such as are not now to be found growing anywhere in the district, are seen in the framework of the older houses, and many localities utterly destitute of trees, bear the name of wood. The destruction of the forests began on the flanks of the mountains, and by degrees descended to the depths of the valleys and ascended upwards to the summits. Then came the Revolution which swept away completely what remained of the woods. The pasturing of flocks rendered the soil, once held firmly together by the interlacing roots of trees, more susceptible to the ravages of water.

It is not surprising that, owing to straits to which the people have been driven for lack of fuel, and the devastation caused by the torrents, large districts once fertile have been depopulated. Here and there on the brows of many hills are traces of old fields and estates, the stone boundary walls of which yet remain now desolate and unoccupied. As regards the effect of excluding flocks and allowing Nature to re-assert herself in providing the mountain slopes with their natural covering, Surell says :

"Some communes, dreading the future, have enclosed some quarters, as the mountain of Channette, quartier de Maniboux, quartier de Lierravasse, quartier de Auroux near Saint Etienne. Immediately vegetation has again gained possession of the soil, the herbage, bushes and shrubs have spread with wonderful rapidity and formed what are called *blanches* in the country. Whole forests have sprung up on the soil of the forests which were destroyed at the Revolution, but which the inhabitants, now inspired by a better feeling, have subjected to a regular course of forest management. Finally, on the same mountain brows, enclosed portions assume by the end of two years, appearances different from that of those given up to the sheep. The latter are bare and cut into ravines ; the former are covered with vegetation, the soil is consolidated, and the ravines carpeted with tufted plants look like cicatrices occasioned by wounds which are under the benignant influence of a topical application. In the two quarters the exposure, the slopes, the soil are the same ; the mere fact of putting them *en reserve* has determined the difference."

M. Surell goes on to say that in every instance the lands which are devastated by torrents of recent origin are found to be stripped of their trees and of all kinds of arborescent vegetation. On the other hand, mountain slopes which have been recently denuded of their timber are invariably found to be indented by torrents of the smaller order, evidently only of late formation. Everywhere where there are recent torrents there are no more forests, and wherever the soil has been stripped of wood, torrents have lately been formed. The names of numerous mountains and torrents, an examination of which has led to these conclusions, are given. There was not at the time he wrote a commune where the older residents could not testify that on such a hillside, then stripped and devoured by the waters, they had formerly seen fine forests standing without a single torrent. Especially after the excessive destruction of woods which followed the Revolution was this great change noticeable, and many great torrents date from this epoch.

The action of forests is not confined to preventing the creation of new torrents, but is a sufficiently powerful influence to extinguish torrents already formed. The injurious result of forest destruction is not only to open everywhere the soil to new torrents, but to augment the violence of those existing, and to resuscitate those which appear completely extinct. The effect of the woods in preventing torrents is thus accounted for :

"When the trees fix themselves in the soil the roots consolidate this, interlacing it with a thousand fibres, their branches protect it as would a buckler against the shock of the heavy rains ; and their trunks, and at the same time the suckers, brambles and that multitude of shrubs of all kinds which grow at their base, oppose additional obstacles to the currents, which would tend to wash it away. The effects of all this vegetation is thus to cover the soil in its nature mobile, with an envelope more solid and less liable to be washed away. Besides, it divides the currents and disperses them over the whole surface of the ground, which keeps them from going off in a body in the lines of the *thalweg* and meeting there, which would be the case if they flowed freely over the smooth surface of a denuded ground. Finally it absorbs a portion of the waters, which are imbibed in the spongy *humus*, and so far it diminishes the sum of the washing away forces. It follows, then, that a forest establishing itself on a mountain actually modifies the surface of the ground, which alone is in contact with atmospheric agents, and all the conditions find themselves there modified as they would be if a primitive formation had been substituted for a formation totally different. Whence it is not more astonishing to see the same soil alternately cut up and free from torrents, according as it is despoiled or clothed with forests, than it is astonishing to see torrents cease when we come to primitive formations, or re-appear suddenly on friable limestone."

A work by Mons. L. Marschand, *Garde-General* of the French forests, published in 1872, embodies the results of observations made for seven years in the valley of Barcelonnette, and also of observations made in the Austrian Alps and Switzerland. The author was led to conclude that the effects produced by trees observed by Surell and others were primarily and chiefly, if not altogether, produced by their roots by modifying the permeability of the soil and increasing its power of retaining water. This was in his opinion the case, even when the ground was rock.

After referring to the natural history of mountains and the modification of their primary conditions caused by aqueous influences, and disintegrations by frost, and pointing out how these agencies were counteracted by vegetation, and afterwards re-asserted themselves on the clearing away of forests, he says :

"There is an action but little observed, but one which goes on with very great activity, in the decomposition of rock. It is that effected by roots. In twelve days the roots of the *phaseolus multiflorus* (the scarlet kidney-bean) has produced on polished marble great markings a demi-millimetre in depth, like the traces of an engraver's tool ; experiments made with other plants and on other kinds of rock gave similar results. Of these twelve days, six were taken by the root in reaching the marble and in the remaining six days these markings were made. It may be inferred that the presence of forests, which develop a great many roots deeply penetrating the ground, will have for its effect considerably to increase the riches of the soil by expediting the decomposition and disintegration of the rock. If we think of the results obtained in a few days by the experiment in question, we may form some idea of the influences of forests acting throughout hundreds of years ; and we may be prepared to admit that the rocky subsoil of the forests, although protected against extreme atmospheric influences, may be disintegrated at least as rapidly as if it had been exposed to the direct influence of the atmosphere through the influence of the roots of trees. It is to this operation that we may attribute the gently rounded forms of calcareous rocks covered by the soil of forests."

Mons. Marschand cites a number of experiments showing that the absorption of water is proportioned to the degree of sub-division of the material composing the rock, and infers that the effect of the roots of trees in gradually pulverising or disintegrating the rock must be to largely increase its power of retaining water. On a permeable soil or subsoil trees create and maintain on the surface a layer of *humus* which serves to retain the moisture. While on rock the roots break up the surface by degrees and increase its permeability. Rain falling on a denuded brow of a hill composed of argilla-

ceous earth moistens the surface which absorbs a great quantity of water, but when once the surface is saturated the transmission of water goes on very slowly from particle to particle in consequence of the minute subdivision of the molecules. The water absorbed remains on the surface and dilutes the superficial layer, which is soon transformed into a thin clay. A layer of greater or less depth will then detach itself from the surface of the mass and flow off in thin mud according as the rain may have been more or less violent. By a gentle rain a superficial layer is moistened, but the water falling slowly may be able to penetrate the soil more thoroughly and the flow will be slighter. If the ground were wooded the foliage would intercept and moderate the rainfall, in addition to augmenting the absorbent power and increasing the permeability of the soil. The mobility of the surface would be increased, but the network of roots would retain the ground so that no amount of direct rainfall could cause it to slip away. The first effect of a forest is to cover the soil with a thick layer of *humus* and of moss, which possess in a high degree the power of retaining moisture. As the greatest storms of rain never do completely saturate the *humus* on wooded soils, it is impossible to form torrents on these.

After extensive surveys from 1884 to 1886, covering 8,645,000 acres, with a view to undertaking the work of reforestation on a systematic and comprehensive scale, the total area to be placed under forest management by the state was fixed at about 790,400 or a fourth of the whole area to be reforested. The operations carried on directly by the government upon the lands most needing them, will cost more than the reforestation of the other three-fourths which are to remain in private hands and to be made valuable by means of state bounties.

The method of treatment is based upon the scheme of ultimately reforesting all the tributaries of each basin susceptible of being washed away. The forest when re-established in its place on the upper basins is of itself capable of insuring the ultimate extinction of the torrent.

Supplementary to the work of reforesting the sides of hills or mountains as a means of preventing torrents, the system of corrective works as a means of mitigating their ravages, in the meantime has been adopted in France with marked success. These works are sometimes in the form of ramified superficial drains, by which the water from melting snow or heavy rains is dispersed in various directions, and prevented from accumulating in a large volume; but more generally barriers or rectifications of the bed of the water course. The object of these is to establish a fixed and definite bed, and prevent erosion and the washing away of the banks by the sudden rush of water. Rough barriers are built up, forming a series of stairs across the channel. In some cases the bed is covered with branches or whole trees thickly piled with their tops up stream where the slope is steep. In addition to these impediments to the too-rapid flow of water, first-class dams of solid masonry are constructed at short intervals across the channel. The effect of these barriers has been to preserve the banks and prevent the torrent devastating the adjoining lands; and also to break the force and rapidity of the rush of the water, and retain the soil and *debris* which the swollen current formerly carried down with it. Retaining walls, or in some cases, large rocks ranged along the banks, have been found a good defence for the shore against erosion. In treating of this subject, Mons. P. Demontzey, Forest Administrator of France, whose assiduous labors during the last quarter of a century have resulted in the redemption of the devastated mountain districts in the south of France, in a paper read before the French Association for the Advancement of Science, gives several instances in which corrective works have been successfully applied to torrents simultaneously with the process of reforesting. The torrent of Bourget empties into the Ubaye just above Barcelonette. The first operations began in 1870, with the re-forestation of all the stable lands of the basin. Woody vegetation has now taken possession of all the basins formerly denuded, and the young forest thus created is increasing from year to year. The unstable lands have been fixed by a series of corrective works begun in 1872. The principal of these have been confined to the middle section of the torrent, and required the construction of twenty dams of masonry, varying from three to eight meters high. The subjection of the Bourget has been assured for nine years by a young forest of 988 acres which occupies the upper basin.

A more arduous task was the subduing of the torrent of Riou-Bourdoux, famous for its devastations, which was classed as incurable, and was in full activity fifteen years ago, cutting under the foot of its banks and starting land slides over enormous areas. In 1875, the work of restoration was undertaken. The bed of the torrent was rectified in the channel of erosion, and the upper basin reclaimed by the planting of 3,000 acres now restored to forest. The torrent has been completely subdued, and an area of 593 acres restored to agricultural use.

The Comte of Péguère, flowing with a steep descent through granitic rocks broken in all directions, which being surrounded with loose, sandy earth, were in a state of great instability, offered great obstacles to the work of subjection. Great avalanches of rock falling down the precipitous slope as the result of a sudden melting of snow or heavy rainfall, were a constant danger to the neighborhood. The construction of a system of walls on such a steep declivity was considered impracticable. The solution was found in removing all loose blocks, the fall of which seemed imminent, re-clothing the shifting and loose sands with grass, and constructing retaining walls of dry rock wherever the accumulation of rocks left no room for vegetation to find a foothold. The execution of the work was exceptionally dangerous and difficult; but it was accomplished in a manner to satisfy the most sanguine expectations, and this dangerous torrent has been repressed.

M. Demontzey, speaking of the success of the French system of reforestation as a means of preventing torrents, says: "The problem offered by the laws of 1860 and 1882 is now solved. Facts have abundantly proved that the solution is neither long nor costly, and that it is only necessary to aid nature by a series of small measures, judiciously conceived and carried on with system and persistence. The 579 square miles of forests recently created in the three regions, whether by the State or by communities and individuals, insure quiet for the future, and demonstrate by their vigorous growth, how empty were the allegations of the politicians, who in 1860 ridiculed the possibility of reforestation. The task, indeed, is hard and thankless. It is on the most desolate mountain heights, or in the depths of gorges, which they alone penetrate, that the foresters do their work quietly, often in the face of public indifference, or even the hostility of selfish interest.

NEW VARIETIES OF TREES.

The address of President, GEORGE L. GOODALE, of the American Association for the Advancement of Science, delivered at the annual convention of that body in Washington, in August of last year, contains many interesting and valuable suggestions on the subject of forestry. Though something has been done of late years in the introduction of new varieties of trees, adapted to our conditions of soil and climate, as Mr. Goodale shows the possibilities of enterprise of this sort are very far from being exhausted. With the rapidly growing demand for timber of all merchantable kinds, and the corresponding diminution of the supply, the question of how best to utilise our waste lands adapted only for tree-culture, by securing the most profitable varieties as regards rapidity and certainty of growth and marketable value, will soon be a very practical one. The concluding portion of the extract from Mr. Goodale's address which follows, contains a useful suggestion to the owners of large tracts of cleared, or partially cleared land in our back townships, which are being covered with a second growth of poplar and other woods at present regarded as of little value. As the address shows, the growth of the wood-pulp manufacture is creating a demand for this kind of timber which is certain to increase, so that before long, the despised second growth, if preserved, may prove a considerable source of revenue. In addition to the poplar, many of the cleared pine lands are producing young pine trees. If a little labor and care were bestowed on regulating their growth, filling up vacant spaces by transplantation, so as to secure something like regularity of distance, and utilise the land to its full capacity, it would prove an excellent investment.

Can we look for new timbers and cabinet woods? Comparatively few of those in common use are of recent introduction. Attempts have been made to bring into great prominence some of the excellent trees of India and Australia which furnish wood of much beauty and timber of the best quality. A large proportion of all the timbers of the South Seas are characterised by remarkable firmness of texture and high specific gravity. The same is noticed in many of the woods of the Indies. A few of the heavier and denser sorts, like jarrah, of West Australia, and Sabicu, of the Carribean Islands, have met with deserved favor in England, but the cost of transportation militates against them. It is a fair question whether in certain parts of our country these trees and others which can be utilised for veneers may not be cultivated to advantage. Attention should be again called to the fact that many plants succeed far better in localities which are remote from their origin, but where they find conditions substantially like those which they have left. This fact, to which we must again refer in detail with regard to certain other classes of plants, may have some bearing upon the introduction of new timber trees. Certain drawbacks exist with regard to the timber of some of the more rapidly growing hard wood trees, which have prevented their taking a high place in the scale of values in mechanical engineering.

One of the most useful soft-wooded trees in the world is the kawri. It is restricted in its range to a comparatively small area in the North Island of New Zealand. It is now being cut down with a recklessness which is as prodigal and shameful as that which has marked our own treatment of forests here. It should be said, however, that this destruction is under protest; in spite of which it would seem to be only a question of a few years when the great kawri groves of New Zealand will be a thing of the past. Our energetic Forest Department has on its hands problems just like this which perplexes one of the new lands of the South. The task in both cases is double: to preserve the old treasures and to bring in new.

The energy shown by Baron von Mueller, the renowned Government Botanist of Victoria, and by various forest departments in encouraging the cultivation of timber trees, will assuredly meet with success. One can hardly hope that this success will appear fully demonstrated in the lifetime of those now living, but I cannot think that many years will pass before the promoters of such enterprises may take fresh courage.

In a modest structure in the city of Sydney, New South Wales, Mr. Maiden has brought together, under great difficulties, a large collection of the useful products of the vegetable kingdom as represented in Australia. It is impossible to look at the collection of woods in that museum, or at the similar and more showy one in Kew, without believing that the field of forest culture must receive rich material from the Southern hemisphere.

Before leaving this part of our subject it may be well to take some illustrations in passing, to show how important is the influence exerted upon the utilization of vegetable products by causes which may at first strike one as being rather remote.

1. Photography makes use of the effect of light on chromatinized gelatine to produce under a negative the basis of relief plates for engraving. The degree of excellence reached in modifications of this simple device has distinctly threatened the very existence of wood engraving, and hence follows a diminished degree of interest in boxwood and its substitutes.

2. Iron, and in its turn steel, is used in ship-building, and this renders of greatly diminished interest all questions which concern the choice of the different oaks and similar woods.

3. But on the other hand, there is increased activity in certain directions, best illustrated by the extraordinary development of the chemical methods for manufacturing wood pulp. By the improved processes, strong fibres suitable for fine felting on the screen, and fit for the best grades of certain lines of paper, are given to us from rather inferior sorts of wood. He would be a rash prophet who should venture to predict what will be the future of this wonderful industry, but it is plain that the time is not far distant when acres now worthless may be covered by trees under cultivation growing for the pulp-maker.

There is no department of economic botany more promising in immediate results than that of arboriculture.

THE INCREASED DEMAND FOR WOOD.

A fact which ought not to be lost sight of by those who own wooded tracts of land or land more adapted for growing timber to advantage than for farming purposes, is that the demand for timber and wood in all its forms is continually on the increase. As the country is cleared the supply is steadily diminishing, and as population increases and the sources from which the supply is drawn become exhausted, the value of timber-yielding land must steadily increase. The men whose foresight now leads them to plant timber, or to carefully preserve the remains of forest, will in a few years be amply rewarded for their expenditure of means and labor in providing for a certain future demand. The following extract from a manual entitled "Practical Forestry," by Andrew J. Fuller, sets forth very clearly the situation in regard to the value of wood of all kinds in the near future:

"No one who is at all familiar with forests and their products needs to be reminded of the importance of having at hand an abundance of wood of various kinds, or how much it contributes to the general welfare and happiness of a nation. But there are those who have not paid much attention to the subject who claim, and no doubt honestly believe, that the great progress made of late years in the use of iron in place of wood in building houses, bridges, piers, ships and other structures, are but indications of what is to follow, and that in a few years there will be no great demand for wood in any form.

"The building of railroads, which reach almost every part of the country, has aided in the distribution of coal and made this in a great measure a more convenient and in many instances a cheaper fuel than wood, but in building these roads a vast quantity of wood has been used and of the best kinds, not only for ties, of which nearly or quite three thousand are put down per mile, but on many of the roads wood is still used for fuel. There is now nearly or quite one hundred thousand miles of railroads in the United States, and we have only to multiply this by three thousand to ascertain that 300,000,000 of ties have been used in their construction, leaving out of account the thousands of wooden bridges and other structures, in the building of which more or less wood is consumed.

The railroads may have assisted very materially in checking the consumption of wood for fuel, but they have probably more than balanced the account in the amount used in their construction. Besides, the 300,000,000 ties must be duplicated every ten years, for the average life of a railroad tie will scarcely exceed a decade, and with nearly all kinds except the best oak it is a year or two less. The demand for railroad ties is not likely to decrease but increase, although as timber becomes scarce and prices advance preserving processes will doubtless be employed to prevent decay. Stone, brick and iron will also come into more general use for building, but the increase in population will also tend to an increase in the demand for other purposes besides that of building.

"It is only a little more than a century since coke was first employed for smelting iron ores. The introduction of this fuel to take the place of charcoal, it was thought, would save the forests of the world from destruction by the charcoal burners, and while it has done much towards making it possible to produce sufficient iron to meet the great and constantly increasing demand, it has not superseded charcoal, and there is probably more charcoal used to-day than at the time when coke was first employed in a smelting furnace. Charcoal is still used in furnaces and forges and there are several establishments in this country that use annually over a million of bushels each, and a score of others that consume from twenty to twenty-five hundred thousand bushels.

"Notwithstanding the number of substitutes that are employed, the demand for and consumption of wood appears to increase, and to-day there is probably more wood used in making boxes of various kinds than there was used in the construction of buildings of all kinds in this country three-quarters of a century ago. Furthermore, no kind or quality, of timber appears to escape the insatiate demands of the artisan of the period, and he not only finds ready uses for the large and small, the hardest, toughest and most durable, but also for the soft and spongy, the latter being preferred for grinding up into wood pulp for making paper.

"Not a year passes during which scores of new devices and inventions of new articles of manufacture are not brought forward that are made in part or wholly of wood, and while singly they may not call for a great quantity, they do in the aggregate use up an enormous amount.

"The invention of a pleasing toy for children has frequently caused the demolishing of hundreds of acres of forests to supply the manufacture of wood used in its construction. It is idle to talk of our natural forests furnishing a supply of wood for the future use of our people. Even with the more careful management and economy in preventing waste, there must soon come a time of great scarcity of all kinds of wood. With an increase in population, there must necessarily follow a corresponding increased demand, because experience has shown that whenever any other material has been substituted for wood, it merely releases a certain amount, or allows it to seek other channels or markets. No matter in what direction we turn, the fact meets us that the best and most valuable forests of the United States are rapidly disappearing, and the sooner we commence as a nation to economise in the use of wood of all kinds, and preserve the forests now existing as well as commence planting new ones, the better it will be for the present as well as future generations."

FOREST MANAGEMENT IN EUROPE.

The importance attached to forestry in Europe as a means of regulating the timber supply, and preserving the climatic conditions may be understood from the very elaborate and complicated system of forest management, which obtains in most continental countries, notably France and Germany, as contrasted with the haphazard methods, and utter want of intelligent system generally prevailing on this continent. A good idea of the subject is given in a paper read some time ago by Dr. Campbell-Walker, before the Otago Institute, in Dunedin, New Zealand, on "Forestry in Germany and France," a portion of which is here reproduced. The extremely complex mechanism of the German and French system would probably be unsuited to this country, but there is surely a desirable medium to be found between the intricate red-tape regulations of the Old World, and comparative lack of system under which many regions which ought to have been kept permanently wooded, here are allowed to lie waste. There are some suggestions in regard to the plan of clearing with a view to reproduction, which may profitably be studied by land owners who wish to preserve their wood-lots in good condition.

When a forest is about to be taken in hand and worked systematically, a surveyor and valuator from the forest staff are despatched to the spot—the former working under the directions of the latter, who places himself in communication with the local forest officer (if there be one), and the local officials and inhabitants interested, and obtains from them all the information in his power. The surveyor, first surveys the whole district or tract, then the several blocks or subdivisions as pointed out by the valuator, who defines them according to the description and age of the timber then standing, the situation, nature of soil, climate, and any other conditions affecting the rate of growth and nature of the crops which it may be advisable to grow in future years. Whilst the surveyor is engaged in demarcating and surveying these blocks, the valuator is employed in making valuations of the standing crop, calculating the annual rate of growth, inquiring into and forming a register of rights and servitudes with a view to their commutation, considering the best plan of working the forest for the future, the roads which it will be necessary to construct for the transport of timber—in fact, all the conditions of the forest which will enable him to prepare a detailed plan for future management, and the subordinate plans and instructions for a term of years to be handed over to the executive officer as his "standing orders." A complete code of rules for the guidance of the valuator has been drawn up and printed, in which every possible contingency or difficulty is taken into consideration and provided for. Having completed their investigations on the spot, the valuator and surveyor return to headquarters and proceed to

prepare the working plans, maps, etc., from their notes and measurements. These are submitted to the board or committee of controlling officers, who examine the plan or scheme in all its details, and if the calculations on which it is based be found accurate, and there are no valid objections on the part of communities or individuals, pass it, on which it is made out in triplicate, one copy being sent to the executive officer for his guidance, another retained by the controlling officer of the division, and the original at the headquarters' office for reference. The executive officer has thus, in his hands full instructions for the management of his range, down to the minutest detail, a margin being, of course, allowed for his discretion, and accurate maps on a large scale showing each subdivision of the forest placed under his charge." . . . "Natural reproduction is effected by a gradual removal of the existing older stock. If a forest tract be suddenly cleared, there will ordinarily spring up a mass of coarse herbage and undergrowth, through which seedling of the forest growth will rarely be able to struggle. In the case of mountain forests being suddenly laid low we have also to fear, not only the sudden appearance of an undergrowth prejudicial to tree reproduction, but the total loss of the soil from exposure to the full violence of the rain when it is no longer bound together by the tree roots. The soil is then washed away into the valleys below, leaving a bare or rocky hillside, bearing nothing but the scantiest herbage. We must, therefore, note how nature acts in the reproduction of forest trees, and follow in her footsteps, as Pope writes :

" First follow Nature, and your judgment frame
By her just standard, which remains the same,
Unerring "—

Acting on this principle, foresters have arrived at a systematic method of treatment, under which large tracts of forest in Germany and France are now managed. The forests of a division, working circle or district, are divided according to the description of the timber, and the prevailing age of the trees ; and it is the aim of the forester gradually to equalise the annual yield and ensure its permanency. With this object he divides the total number of years which are found necessary to enable a tree to reach maturity, into a certain number of periods, and divides his forest into blocks corresponding with each period or state of growth. Thus, the beech having a rotation of 120 years, beech forests would be divided into six periods of twenty years each—that is to say, when the forest has been brought into proper order, there should be as nearly as possible equal areas under crop in each of the six periods, viz.—from one year to twenty, from twenty to forty, and so on. It is not necessary that the total extent in each period should be together, but it is advisable to group them as much as possible, and work each tract regularly in succession, having regard to the direction of the prevailing winds. When a block arrives in the last or oldest stage, felling is commenced by what is called a preparatory or seed clearing which is very slight, and scarcely to be distinguished from the ordinary thinning carried on in the former periods. This is followed by a clearing for light in the first year after seed has fallen (the beech seeds only every fourth or fifth year), with the objects of : First, preparing the ground to receive the seed ; second, allowing the seed to germinate as it falls ; and third, affording sufficient light to the young seedling. The finest trees are, as a rule, left standing with the two-fold object of depositing the seed and sheltering the young trees as they come up. If there be a good seed year and sufficient rain, the ground should be thickly covered with seedlings within two or three years after the first clearing, nature being assisted when necessary by hand sowing, transplanting from patches where the seedlings have come up very quickly to the thinner spots, and other measures of forest craft. When the ground is pretty well covered, the old trees are felled and carefully removed, so as to do as little damage as possible to the new crop, and the block re-commences life, so to speak, nothing further being done until the first thinning. The above is briefly the whole process of natural reproduction, which is the simplest and most economical of all systems, and especially applicable to forests of deciduous trees. The period between the first or preparatory clearing and the final clearing, varies from ten to thirty years, the more gradual and protracted method being now most in favor, particularly in the Black Forest, where the old

trees are removed so gradually that there can scarcely be said to be any clearing at all, the new crop being well advanced before the last of the parent trees is removed. This approximates to "felling by selection" [*jardinage*] which is the primitive system of working forests in all countries, under which in its rude form, the forester proceeds without method, selecting such timber as suits him irrespective of its relation to the forest increment. Reduced to system, it has certain advantages, especially in mountain forests, in which, if the steep slopes be laid bare area by area, avalanches, landslips, and disastrous torrents might result, but the annual output under this system is never more than two-thirds of that obtained by the rotation system, and there are other objections which it is unnecessary to detail in this paper, which have caused it to be rightly condemned, and now-a-days only retained in the treatment of European forests under peculiar or special circumstances."

THE INFLUENCE OF FORESTS ON CLIMATE.

All recognised authorities on climatology are practically agreed as to the immense influence of forests upon the climate, and the almost irreparable injury inflicted upon the older centres of Eastern civilisation by the destruction of the woods, which alone rendered the soil productive and capable of sustaining a large population. The cause of the decline and depopulation of so many once fertile and highly civilised countries is admirably set forth by Prof. Schleiden, of the University of Jena, Germany. The subjoined extract from his writings is full of warning to those who by their personal experience in noting the unfavorable changes of climate and agricultural conditions in our own land, can realise that the same process of steady deterioration has already set in, in the older settled portions of this Continent:

"Almost everywhere in the great characters in which Nature writes her chronicles, in fossilised wood, layers of peat and the like, or even in the little notes of men, for instance in the records of the Old Testament, occur proof, or at least indications, that those countries which are now treeless and arid deserts, part of Egypt, Syria, Persia and so forth, were formerly thickly wooded, traversed by streams now dried up or shrunk within narrow bounds, while now the burning glow of the sun and particularly the want of water, allow but a sparse population. In contrast must not a jovial toper laugh indeed who looks from Johannisberg out over the Rhine country, and drinks a health in Rudesheimer to the nobliest of the German rivers, if he recall the statement of Tacitus that not even a cherry, much less a grape, would ripen on the Rhine! And if we ask the cause of this mighty change we are directed to the disappearance of the forests. With the careless destruction of the growth of trees man interferes to alter greatly the natural conditions of the country. We can indeed now raise one of the finest vines upon the Rhine, where two thousand years ago no cherry ripened; but on the other hand, those lands where the dense population of the Jews was nourished by a fruitful culture are in the present day half-deserts. The cultivation of clover requiring a moist atmosphere has passed from Greece to Italy, from thence to Southern Germany and already is beginning to fly from the continually drier summers there to be confined to the moister north. Rivers which formerly scattered their blessings with equal fulness throughout the whole year, now leave the dry and thirsty bed to split and gape in summer, while in spring they suddenly pour out masses of snow accumulated in winter, over the dwelling places of affrighted men. If the continued clearing and destruction of forests is at first followed by greater warmth, more southern climate, and more luxuriant thriving of the more delicate plants, yet it draws close behind this desirable condition another which restrains the habitability of a region within as narrow, and perhaps even narrower, limits than before. In Egypt no Pythagoras need now forbid his scholars to live upon the beans; long has that land been incapable of producing them. The wine of Mendes and Mareotis, which inspired the guests of Cleopatra—which was celebrated even by Horace—it grows no more. No assassin now finds the holy pine-grove of Poseidon, in which to

hide and lie in ambush for the singers hastening to the feast. The pine has long since retired from the invading desert climate to the heights of the Arcadian mountains. Where are the pastures now, where are the fields around the holy citadel of Dardanus, which at the foot of the richly-watered Ida supported three thousand mares? Who can talk now of the 'Xanthus' with its hurrying waters? Who would understand now the 'Argos feeder of horses?' . . . A broad band of waste land follows gradually in the steps of cultivation. If it expands, its centre and cradle dies, and on the outer borders only do we find green shoots. But it is not impossible, it is only difficult, for man, without renouncing the advantage of culture itself, one day to make reparation for the injury which he has inflicted: he is appointed lord of creation. True it is that thorns and thistles, ill-favored and poisonous plants, well named by botanists "rubbish plants" mark the track which man has proudly traversed through the earth. Before him lay original Nature in her wild but sublime beauty, behind him he leaves the desert, a deformed and ruined land; for childish desire of destruction, or thoughtless squandering of vegetable treasures, have destroyed the character of nature; and man himself flies terrified from the arena of his actions, leaving the impoverished earth to barbarous races or animals, so long as yet another spot in virgin beauty smiles before him. Here again in selfish pursuit of profit, consciously or unconsciously, he begins anew the work of destruction. Thus did cultivation, driven out, leave the East and the deserts perhaps previously robbed of their covering. Like the wild hordes of old over beautiful Greece, thus rolls this conquest with fearful rapidity from East to West through America, and the planter often now leaves the already exhausted land, the Eastern climate becoming infertile through the demolition of the forests, to introduce a similar revolution into the far West. But we see, too, that the nobler races or truly cultivated men, even now raise their warning voices, put their small hand to the mighty work of restoring to Nature her strength and fullness in yet a higher stage than that of wild nature; one dependent on the law of purpose given by man, arranged according to plans which are copied from the development of manhood itself. All this, indeed, remains at present but a powerless and for the whole, an insignificantly small enterprise, but it preserves the faith in the vocation of man and his power to fulfill it. In future times he will and must when he rules, lead and protect the whole, free Nature from the tyrannous slavery to which he now abases her, and in which he can only keep her by restless giant struggles against the eternally resisting. We see in the gray cloudy distance of the future a realm of peace and beauty on the earth and in nature, but to reach it must man long study in the school of nature, and before all free himself from the bonds of that exclusive selfishness by which he is actuated."

Elisee Reclus, the eminent French geographer, in his work, "*La Terre*," treats of the climatic influence of forests as follows:

"One may say in general terms that the forests are similar to the sea in their influence, reducing the natural differences of temperature in the different seasons, while the destruction of forests increases the difference between the extreme heat and the extreme cold, imparts greater violence to atmospheric currents and to torrential rains, and a protracted violence to drouths . . . Marsh fevers even and other epidemic diseases have often made an irruption into a district when woods or simple screens of protecting trees have fallen before the axe. As for the water flow, the climatic conditions on which it depends, one cannot doubt for a moment that the clearing away of woods has had the effect of disturbing its regularity. The rain which the interlaced branches of the trees allow to fall drop by drop, and which would swell up the spongy mosses upon which it fell, or which would trickle slowly across the dead leaves and the long fibrous masses of the roots, flows away at once with rapidity over the soil to form temporary streamlets, in place of sinking into the ground to descend to the depths and rise again in fertilising springs, or glides rapidly along the surface, and goes to lose itself in rivers and floods. The ground above becomes arid in the same proportion as the running waters increase below. The full rivers flowing become changed into inundations, and devastate the adjacent country, where immense disasters follow."

MR. VANDERBILT'S FOREST AND NURSERY.

It is interesting to note that in some directions the efforts of the government to preserve or restore the forests, are being seconded by private enterprises on a large scale. One of the most notable of such undertakings in the United States is the extensive forest estate and nursery of George W. Vanderbilt near Biltmore, North Carolina, now being laid out. The design is that the greater portion of the estate shall be occupied by a systematically managed forest, principally comprising such trees and bushes of indigenous growth as are of commercial value. Its extent will be fully 4,000 acres. A portion of the area is at present covered by second growth timber which will be thinned out, and considerable spaces now bare or occupied with undesirable trees will be planted. Roadways will be constructed through the forest, an eye being had to picturesque effect as well as to convenience. It is proposed to make a plantation three or four miles in length along the borders of some of the forest roads which will contain specimens suitably classified and arranged for study of each of the native trees of the region, as well as of all trees obtainable from any part of the world, which can be expected to flourish under the prevailing conditions of soil and climate. This will be styled "the Arboretum," and if the design is successfully carried out will be a collection of great scientific value and practical interest.

In some of the glens of the estate it is proposed to form landscapes of local scenery resembling those naturally prevailing in many similar situations in the North Carolina mountain region, of which the more notable features are lustrous, smooth-leaved evergreens, such as the *Rhododendrons* and *Kalmias*, *Ilexes* and the *Lencothæ*. With these will be associated a smaller number of foreign bushes of a similar character, the introduction of which if they can be successfully naturalised, will add a pleasing variety to the prospect. The partly flooded or water soaked areas which are overgrown with cane, bull-rushes, *sagittarias* and other aquatic forms of vegetation, will be diversified by the introduction of a few foreign plants of like nature such as certain *Bamboos*, *Nelumbiums* and *Nymphæas*, to the cultivation of which the surroundings are favorable.

In the nursery there are under propagation or already in cultivation young trees and bushes in very large variety. Of those designed to be set out or used as stocks for propagation for the Arboretum, there are two or more specimens each of 4,200 species and varieties. The whole stock of trees and bushes of merchantable size numbers about 100,000, and of seedlings and cuttings propagated on the grounds during the last season about 500,000. Some of the stock has been brought from long distances, as the Alpine regions, Europe, the Ural and Himalayan ranges of Asia, and Japan have all been laid under contribution. The undertaking is one the results of which can only be realised after many years, and in devoting a portion of his superfluous wealth to so worthy an object, and one quite beyond the reach of individuals or institutions not having very extensive resources at their command, Mr. Vanderbilt has set a worthy example to his fellow-millionaires.

NATIONAL PARKS AND FOREST PRESERVES.

Considering that it is only a very few years since the belief was general that this continent possessed a practically inexhaustible supply of timber, and all idea of preserving the forests for the benefit of future generations was pooh-poohed as absurd and unnecessary, it is very gratifying to note the marked awakening of public sentiment to the need of forest preservation, as indicated by government action both in Canada and the United States. There is perhaps no practical question on which popular opinion has advanced more rapidly. In the United States, where the timber supply has been more nearly exhausted by reckless cutting than is yet the case in Canada, it is conceded on all hands that the time has arrived to call a halt to the work of devastation and take energetic

measures to protect the remaining woodlands. An earnest of this great change in public feeling is seen in the very comprehensive forestry measures which have resulted in the setting apart as national forest reservations the Yosemite, Yellowstone, and Sequoia Parks in the west, and the similar movement in New York State to secure from spoliation the great forests of the Adirondacks covering the region in which the rivers of that state take their rise. The Dominion Government a few years ago took similar enlightened action in reserving the beautiful Rocky Mountain Park at Banff, in the North-West, where a large area of magnificently timbered land has been set apart as a health and pleasure resort, and strict regulations adopted to preserve the timber within its boundaries.

In thus withdrawing large areas of wild land from private ownership unadapted for permanent settlement or successful cultivation, and preserving them as public domains, several useful and essential purposes are served. The most important of these is unquestionably the preservation of the natural forest from the ravages of the axe and fire, doing something to retain a due proportion of woodland to avert the evils resulting from the excessive denudation of the country. The advantages which these reserved areas will afford as sanitariums, and resorts for those in search of rest and recreation are obvious. There the many species of game and other varieties of wild animals and birds which might otherwise speedily become extinct will be carefully preserved, and in after ages the scientist and student of nature will be enabled to form an idea of the primæval condition of the country.

There are in the Northern portion of Ontario extensive regions, partially timbered, which except in patches here and there are entirely unfitted for successful cultivation on account of the rocky and broken character of the ground. This region includes the head waters of the principal rivers and streams of Ontario, and the extent to which it has been devastated by timbering and forest fires has resulted in very considerably reducing the volume of water. Every consideration points to the desirability of the Provincial Government laying out a large area in the northern section of the Province to be withdrawn from settlement and retained as a Provincial Park, under strict forestry management.

FORESTRY IN THE U. S.—NATIONAL PARKS.

The annual report of the United States Secretary of the Interior for the fiscal year ending June 30th, 1891, shows that the question of preserving the forests from destruction in order to secure an adequate supply of timber in the future, and to prevent the recurrence of floods and drouths, is receiving increased attention at the hands of the American Government. Owing to the rapid settlement of the public lands adapted for agricultural purposes, the irrigation of the arid regions of the West, so as to render them available for cultivation, has become an important problem. It is estimated that 120,000,000 acres now desert may be redeemed by irrigation so as to produce the grains, fruits and vegetables otherwise adapted to the locality. The close connection between the systems of forestry and irrigation is indicated by the following passage in the report:

"Connected with the water supply of the arid regions, is the necessity at this time of making systematic reservations from settlement of public lands about the heads of the streams that make irrigation possible. Indeed such reservations should be made for all our streams, but especially for those above referred to. If the timber growth is removed, without consideration for the future, the periods during which the streams give their present supply of water will be greatly shortened by floods and drouths."

The more consideration which is given to the now urgent problem of irrigation as a means of enlarging the cultivable area of the United States, the greater will appear the absolute necessity of insisting upon forest preservation as an essential factor in securing a steady and copious water supply. The report calls attention to a very serious mistake made by the Government in permitting the passage of an act to repeal timber-culture

laws, which contains the remarkable provision that in the States of Colorado, Montana, Idaho, North Dakota, South Dakota, Wyoming, the District of Alaska and the gold and silver mining regions of Nevada and Utah, in any prosecution for a trespass on public timber lands, "it shall be a defence if the defendant shall show that the said timber was so cut or removed from the timber lands for use in such state or territory by a resident thereof for agricultural, mining, manufacturing or domestic purposes, under rules and regulations made and prescribed by the Secretary of the Interior, and has not been transported out of the same." According to this very sweeping and comprehensive provision the only safeguard remaining for the timber in the states included are such regulations as the Secretary sees fit to enforce, as no one could cut timber for any purpose not coming under the head of "agricultural, mining, manufacturing or domestic," unless it were in mere wantonness. The relaxation of the law is stated to have resulted in a very large number of applications for permits to cut timber, and it is anticipated that the rapid increase in these will, unless the law is repealed or modified, leave but little timber in these regions to protect. As an available means of preventing or postponing so undesirable a result the report calls attention to a clause of the Act under which the President is empowered to set apart and reserve any part of the public lands wholly or partly timbered as public reservations. If this authority is freely exercised it may prevent the threatened calamity. Action was taken under this law on March 30th and September 10th, 1891, when the President proclaimed a reserve about the Yellowstone National Park, which it is recommended should be annexed to that valuable national possession, and on October 16th, 1891, when the White River Plateau in Colorado, embracing the head waters of the White, Grand and Yampa rivers, was proclaimed a reserve. The report recommends that Congress take proper action to have the reservations that are constituted by the President established as national parks or granted to the States in whose borders they are situated, to be preserved unimpaired and used for the benefit of the public only. The American Forestry Association, and those interested in forestry have petitioned to have other reserves made, and the Commissioner of the General Land Office and the Director of the Geological Survey are making investigations upon which to base further recommendations. It is to be considered that these parks would preserve the fauna, fish and flora of the country, and become resorts for those seeking instruction and recreation, at the same time that they serve important agricultural and economic purposes. It is urged that details from the army should be authorised to guard the reserves from early spring to late autumn, or that a police force for that purpose should be employed, and that penalties against violation of the rules and regulations made to govern the reserves should be enforced.

During the year 488 cases of depredation on the public lands involving timber and its products to the value of \$2,347,473.11, of which a total of \$116,704.57 was recovered either by accepting propositions for settlement or through legal proceedings. On the 1st of July, 1891, there were pending in the courts 203 civil suits for the recovery of an aggregate amount of \$4,451,305.07 for the value of timber unlawfully cut from public lands, and 361 criminal prosecutions for the cutting or removing of timber in violation of law. The appropriation to meet the expenses of protecting timber on the public lands amounted to \$100,000,

Among other details as to the condition of the forests of the territories given in the report are the following: The fine forests of Northern and Central Arizona cover an area of 1,750,000 acres, and there is an abundant supply of timber for the consumption of a large population for a great number of years. The expense of transportation renders the price too high for competition with outside markets. Ten thousand millions of feet is the estimate made as to the quantity of pine timber fit for sawing purposes. It is urged that as the future agricultural development of the territory depends largely upon an abundant and permanent supply of water, which in turn depends on the proper preservation of the forests, legislation should be framed to preserve the present timber-growing areas.

In New Mexico the extension of the Union Pacific Railroad into the Red River country and on the Maxwell grant brought into the market about 200,000,000 feet of

spruce and pine timber, and there are now seven mills in operation, cutting about 3 000,000 feet per month. Besides the sawn lumber there are about 20,000,000 ties and other timber already in reach. In other sections vast quantities were cut during the year, 20,000,000 feet being cut from the Tierra Amarilla grant. The proposal to establish a national park on the Upper Pecos to protect the timber about its head waters is strongly urged.

In Alaska dense forests and abundance of timber are found. Spruce, hemlock, cedar, birch and poplar being the principal growths. The timber business is much harassed by the unfortunate condition of the land titles. The depredations reported during 1890 amounted to 10,000,000 feet, worth \$250,340.

The report, in dealing with the Yellowstone National Park, regrets the absence of any law to punish depredations there. The attention of Congress has often been called to the subject, and a penal statute introduced, but coupled with an amendment foreign to its purpose, granting the right of way to a railroad through the park, and those instrumental in urging the Bill thought it better it should fail than pass with such a provision. The Secretary of the Interior considers that a railroad would be detrimental to all the purposes for which the park was established, and that if the franchise were once granted it would result in the practical abandonment of that region as a forest and game reserve. A large tract of forest land lying to the South and East of the park in the State of Wyoming has been reserved from settlement by the President, and Congress has been asked to include it in the boundaries of the park.

The Yosemite National Park includes among its forest growths nine varieties of pines, growing at all elevations, from 2,500 to 11,000 feet above sea level, the tamarack flourishing at the highest altitude of any. The cedar grows to great dimensions, at from 4,000 to 7,000 feet. Two varieties of spruce grow at from 5,500 to 8,000 feet altitude, and three varieties of the fir at from 7,000 to 9,000 feet. At an altitude of about 8,000 feet, specimens of the juniper have been seen. The black and live oak grow in the valley, only at 4,000 above sea level, at which height there are also a few cottonwood and balm of gilead trees. At 5,000 to 6,000 feet are a few dwarf quaking aspen. There are two small groves in this park of the wonderful *sequoia gigantea* which is indigenous at elevations between 5,500 and 7,000 feet. The same difficulty in management presents itself here as in connection with the Yellowstone Park, owing to the absence of laws providing criminal penalties for violation of the regulations.

The Sequoia National Park has been put in a condition to preserve the celebrated *sequoia gigantea* (from which it is named) from injury or destruction. The Giant Forest, as the sequoia groves are termed, is in its natural state except for a few cabins and some fenced ground. One tree is thirty-four and a-half feet in diameter, and 370 feet in height. In other groves, the sequoia trees form but a small proportion of the forest growth, being scattered here and there among fir, spruce and pine trees. In the Giant Forest they are the majority, and grow more thickly and to a greater size than anywhere else in California. It is the most remarkable forest of its kind in the world. The Superintendent of the park states in his report that the prosperity of the population living in the valley between the Sierra Nevada's and Coast Range depends upon the preservation of the timber and brushwood in the mountains, the brushwood covering the lower slopes and foothills to an altitude of about 5,500 feet where the timber commences, and extending to between 10,000 and 11,000 feet, where there is enough soil to support the trees. The brush and timber assist in holding back the snow and prevent disastrous snow slides, and also keep it from melting too rapidly in the spring, thus preventing floods and equalising the water supply. Sheep destroy much of this brush, and herders often set fire to it in the fall in order that the ground may furnish a good supply of grass next season. Protection against this evil must be sought from the national or state government.

The following memorial from the American Association for the Advancement of Science, relating to the preservation of the forests on the public domain was, on January 20th, 1890, transmitted by the President to Congress, with an earnest request that legislation to that end might be provided, a recommendation which was partially complied with.

MEMORIAL OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE IN
BEHALF OF A PROPER FORESTRY POLICY.

To the President of the United States :

The first national legislation which recognised the necessity of looking after the forestry interests of the country in general, grew out of the representations made before Congress fifteen years ago by a committee of the American Association for the Advancement of Science.

These representations led to the appointment in the year 1887 of an agent, and later, the establishment of a forestry division in the Department of Agriculture, for the purpose of gathering and making accessible such information as would lead our people to a proper conception of the value and significance of a forest cover in the economic life of our nation.

Twelve years have passed, during which sufficient knowledge of our forest conditions and of the general relations of these to cultural, climatic, and economic conditions has been gathered, to show that further action on the part of the General Government is necessary if we wish to preserve this relation favorable to the future development of the country.

The American Association for the Advancement of Science, actuated alone by a desire to promote a rational development of the country's resources, has therefore appointed the undersigned committee to memorialise the President and Congress of the United States under the following resolution :

"Resolved, That it is the sense of the American Association for the Advancement of Science that immediate action should be taken looking to the establishment of a proper administration of the remaining timber lands in the hands of the Government of the United States and Canada, for the purpose of insuring the perpetuity of the forest cover on the western mountain ranges, preserving thereby the dependent favorable hydrologic conditions.

"Resolved further, That a committee of five be, and is hereby, appointed to present this resolution, and to urge the importance thereof to the President and the Congress of the United States, and to the Premier and Parliament of Canada and of the provincial governments, and that such committee be instructed to prepare in proper form any data necessary, and to use every honorable means to accomplish the purpose herein set forth, and that the President of this Association be hereby appointed chairman of such committee, together with four others whom he shall appoint."

The committee in presenting this memorial desire not to argue at length any theory as to forest influences, or to discuss the present unsatisfactory condition of our forest areas and national timber lands—which has been amply done in the reports of the Secretaries of Agriculture and of the Interior—but they respectfully submit in support of the request of the Association such points as will explain and justify the presentation of this memorial.

(1) The action which is asked of Congress concerns only a particular part of our forest area, that part which is in possession of the General Government, the property of the nation.

(2) It is asked upon the presumption that the present administration of this property, probably from ignorance of its proper value and its real significance, is unsatisfactory, and that a change of policy is immediately urgent if this value is to be retained, and the far-reaching injury, which from its present rapid deterioration may be anticipated, is to be avoided.

(3) It is asked upon the presumption that the value of the property, situated mainly upon the watersheds of our Western river systems, lies much more in its significance for the future cultural development of a vast adjoining country than in the material which it now furnishes to the pioneer settler and miner.

(4) It is also assumed that the only proper person to administer this property for the benefit of the country at large, and the preservation of the dependent cultural conditions is the Government itself, which alone can have an interest in the future of society beyond present and personal gain.

As the reports cited have shown, the administration of the timber lands has been unsatisfactory for lack of proper legislation and of provisions sufficient to protect this property against material loss and deterioration. Timber thieving and destruction by fire have been allowed to unnecessarily waste this national property, while the officers in charge were powerless to protect it. The pioneer legislation, which may have been sufficient twenty-five years ago, has long outlived its usefulness, and should make way for such administration as will meet the demands of civilized existence in settled communities.

A vast empire, considered useless not long ago, has been found capable of human occupancy and agricultural production, if the means for its development, water, can be brought upon it, and the extent to which this land may be utilized depends upon the amounts of water available.

The opinions of our greatest climatologists have been divided as to the influence of forests on precipitation. But evidence, carefully and scientifically scrutinised, is accumulating which tends to show that, under certain conditions at least, such influence may not be improbable. However this may be, overwhelming evidence can be brought to show that a potent influence upon the distribution of available water supplies from rain and snow is exerted by a forest cover, so that a government having to deal with the problem of cultural development of a part of its domain by irrigation can not compass the water question without at the same time giving attention and proper regard to the forestry question.

Removal of the mountain forest means invariably disturbance of the natural "run-off;" favorable sometimes, unfavorable mostly.

It may be difficult to devise at once such a plan for the administration of these forests, with a view to their continuity, as can be put in practice under the present social and political conditions of that part of our country in which this timbered area is situated; and a special investigation of these conditions and careful adjustment between the present needs of the population for wood material and the future needs of a forest cover for hydrologic purposes appears desirable, although various measures for a forest administration which seems capable of practical application have been proposed.

We, therefore, the undersigned committee, in the conservative and scrutinising spirit that should characterise the proposition of the scientific body which we represent, respectfully recommend:

That a joint committee of the Senate and House of Representatives of the United States, be appointed to consider the needs of legislation in behalf of the public timber domain, with a view of providing for the appointment of a commission of competent men, salaried and employed for this service alone, for the purpose of investigating the necessity of preserving certain parts of the present public forest area as requisite for the maintenance of favorable water conditions, and to devise a practical plan for the permanent administration of such parts of it as shall appear desirable to be retained under Government control.

The committee further recommends that, pending such investigation, all timber lands now in the hands of the United States be withdrawn from sale and provision be made to protect the said lands from theft and ravages by fire, and to supply in a rational manner the local needs for wood and lumber until a permanent system of forest administration be had.

It is also suggested that inasmuch as the various Departments and Government Bureaus, namely, the Department of Agriculture in its Forestry Division, the Department of the Interior in its Land Office and Geological Survey, the Department of War in its Signal Office, the Treasury Department in its Coast and Geodetic Survey, are more or less closely interested in this matter, and have collected data useful in the work of such a commission, these Departments should co-operate and act as advisers of said commission.

T. C. MENDENHALL,

President of the Association and Chairman.

B. E. FERNOW, of New York,

Secretary.

E. W. HILGARD, of California,

C. E. BESSEY, of Nebraska,

WM. SAUNDERS, of Canada.

Committee.

THE PROPOSED ADIRONDACK PARK.

The fifth annual report of the Forest Commission of the State of New York, for the year 1890, comprising Messrs. Townsend Cox, Sherman W. Knevals and Theodore B. Bassolin, embodies a considerable amount of valuable information as to the work of the Commission in connection with the Adirondack and Catskill forest preserves in that State, and the more comprehensive scheme of the contemplated Adirondack Park. The report states that the remarkable exemption from fire, so noticeable in 1888 and 1889, has continued during 1890. As before, it is undoubtedly due in a large extent to the rules and regulations which have been thoroughly posted throughout the Adirondack and Catskill preserves, and to the vigilance of the fire wardens. The widespread distribution of these printed rules of the Commission regarding the use and abuse of fire has reduced the prevalence of dangerous fires to a minimum, while the efficient organisation of the fire-warden system, under which one or more active officials are ready at all times for duty in each town (the New York "town" corresponds to the Canadian township) has prevented the fires, when started from doing any serious damage.

The rules and regulations for the prevention of forest fires are printed on heavy cards twelve by fifteen inches, or latterly upon white muslin, as this material has proved more durable, most of the placards being posted in the woods, or on fences, schoolhouses and mills, where they are exposed to the weather. Over 15,000 of these rules have been posted by the foresters and firewardens throughout the preserve counties, and the Commission believes that much of the immunity from fire is due to their general distribution. They have been an important aid in warning the careless and in educating the people in this particular. The rules are as follows:

RULES FOR THE PREVENTION AND SUPPRESSION OF FOREST FIRES AND FOR THE PROTECTION OF FOREST TREES.

1. All persons intending to light fires for the purposes of clearing or improvement must give notice of their intention to the nearest firewarden before such fire is lighted.

2. No fires of the character before specified will be permitted until the trees are in full leaf. After such fires are lighted competent persons must remain to guard them until the fire is completely extinguished.

3. Fires will be permitted for the purpose of cooking, warmth and insect smudges; but before such fires are kindled, sufficient space around the spot where the fire is to be lighted must be cleared from all combustible material; and before the place is abandoned fires so lighted must be thoroughly quenched.

4. All fires other than those hereinbefore mentioned, are absolutely prohibited.

5. Hunters and smokers are cautioned against allowing fires to originate from the use of firearms, cigars and pipes, and all persons are warned that they will be held responsible for any damage or injury to the forest which may result from their carelessness or neglect.

6. Felling trees and girdling or peeling bark from standing trees are prohibited. Fallen timber only may be used for firewood and camp construction.

7. Foresters and firewardens are instructed, and all citizens are requested, to report to the forest commissioners immediately all cases of damage or injury to forest trees arising from a violation of these rules, which may come to their knowledge.

Since the publication of the previous report trespasses on State lands throughout the forest preserves have continued to diminish in number and extent, a result due in part to increased vigilance in protecting timber lands, but owing largely to the change in public sentiment among the people living in the timber district in regard to the custom of cutting timber on State lands.

The Commission report a total expenditure of \$24,891.20, being \$5,108.80 less than the appropriation of \$30,000 for the work. Although since 1888 the area of State holdings has been largely diminished by the redemption of lands forfeited for non-payment of taxes, these losses have been more than compensated by accessions, and there has been a net increase of 81,149 acres in the area of the preserve since the Commission took charge, the area on December 31st, 1885, being 715,267 acres as compared with 796,416 acres on January 1st, 1891.

The report embraces a special report made by the Commission to the State Legislature dealing with the message of Governor Hill, which called attention to the subject of establishing a State Park in and about the head waters of the rivers having their sources in the Adirondack wilderness, and was referred to the Forest Commission with instructions to investigate the possibilities of such an undertaking and report their recommendations as to the most effective methods to accomplish it. The regions popularly known as the Adirondacks is one of undefined extent.

In years gone by the wild lands of the Adirondacks have been stated to cover 12,000 square miles, which was doubtless an over estimate, and included lands not properly belonging to the Adirondacks tract. Villages, settlements, farms and clearings have been established all around its borders, and have made large encroachments upon the original acreage. Taking the most reliable data obtainable the gross area of the Adirondack wilderness proper is shown now to be about 5,600 square miles, or 3,600,000 acres, which includes the area of water, everflowed lands, clearings, farms, and some villages or settlements. Of this estimated gross area of 3,600,000 acres the State has acquired title to a total area of 765,036 acres inclusive of water and overflowed lands. This is not compact, but lies in widely separated parcels, varying in extent and interspersed among tracts held by individuals and corporations, some of whom have established private preserves and parks in the woods for purposes of pleasure and recreation. There must be some scheme adopted by which an area could be consolidated sufficiently large to render the establishment of a park expedient. The Commissioners consider the exercise of the right of eminent domain at present impracticable, as it would arouse hostility and defeat the entire park scheme. They regard the proposal to purchase the lands held by private owners as more feasible, though widely conflicting opinions as regards the amount required for the purpose were found to prevail.

While public opinion as a whole has been from the first strongly in favor of the park, objections to it have come from two classes of people, as was anticipated, though not very strongly or definitely expressed. The first class of possible opponents are the clubs and various associations and individuals who are holding land in the Adirondacks for purposes of pleasure or as summer resorts.

The number of these has greatly increased since the agitation of the park scheme, These private reserves being mostly held by men of means, are not for sale. Another class from whom objection was anticipated are those interested in lumbering and paper-making. The State holdings are interspersed among and bounded on every side by immense tracts held by timber dealers and paper-makers, who have paid for their lands and have built saw-mills and pulp-mills and dams and other structures at a great expenditure

of money. It became evident that there must be devised some system of adjustment and *modus vivendi* between the State on the one hand and those owning private reserves and lumber lands on the other, under which the park could be established, leaving the rights and privileges of all undisturbed. With this end in view the Commission invited representatives of all private interests to present their opinions and informally discuss the entire subject in all its bearings. The fact was elicited that the owners of private reserves were unanimously in favor of the park, provided certain privileges were conceded them. The claims made on behalf of the private reserves are that while the aim of their establishment may differ from that of the State park they are practically accomplishing the precise object sought, viz., the preservation of the forest.

With one or two exceptions timber is not allowed to be cut, fire is guarded against and no acts of depredation or trespass allowed. The Commission came to the conclusion that the chief objectionable feature of the reserves, the exclusion of the public from private reserve lands, can be by negotiation and mutual concession removed, and that it does not seem to be essential to the full success of the park scheme that the State should immediately acquire the lands included in the private reserves, it being of less consequence who shall preserve the forests than that they should be preserved. The real purpose can be served by an agreement with the owners of the reserves that their lands shall be managed under the same system and subject to the same regulations as the park, the title to remain for the time in the present owners as an offset to a concession on their part that the public shall have access to their lands, and that if they are ever offered for sale the State shall have the refusal to purchase.

As to the lands held by lumbermen it is essential that much of that area should be eventually owned by the State, and there should be a method inaugurated, having for its object the gradual acquisition of lands for the park as opportunities arise.

Many parcels of land, some fairly well covered with timber, lie scattered in small tracts so far from the main body of the Adirondack lands as to be unavailable for park purposes. These lands can be exchanged, on a fair business basis, for lands within the proposed park area now owned by individuals. Still further, it is proposed that the State acquire title to land now owned by lumbermen within the proposed park area, under condition that the "soft wood" (thereby meaning spruce, hemlock, pine and tamarack) may be cut and taken out within a specified time, under conditions to be established. The mature timber standing on the land owned by the State might be exchanged under conditions of a like sort, for lands desirable to be enclosed within the State park. In this way the land on which such growing timber stands could be retained by the State, and new lands acquired, which, in a few years in the course of nature, will be recovered with a new forest growth.

The report points out that the true interests of the lumbermen are not incompatible with forest preservation. Under the old practice of cutting the forests have rapidly disappeared, and if it continues in a few years none will be left. The lumberman will have ruined his own business. It is the purpose of forestry to point out to the lumberman the true methods of exercising his own profession, which will provide him material for the future as well as the present by maintaining permanent forests through a succession of crops. The lands acquired for the park can be, doubtless, brought under a system of good forestry management and permanent forests established thereon.

The Commission believes it to be good policy for the State to acquire timbered and even denuded lands for park purposes, since these lands can be obtained at a small cost, and it is a well-established fact that if a tract of cleared or even cultivated land is for any considerable length of time abandoned and kept free from destructive agencies the forest re-asserts itself, and the soil is soon covered with an arborescent growth.

The minimum area for a park suggested to the Commission is 1,600 square miles or about 1,000,000 acres, while most have urged larger areas ranging from 2,500,000 to 4,000,000 acres. The actual size must depend ultimately upon the liberality of the legislature, and this in turn will depend largely upon public opinion. According to the scheme recommended by the Commission the park includes a gross area of 2,307,760 acres, of

which 54,104 acres are water, 64,717 acres improved lands, 341,207 private reserves, and 512,229 acres State lands. Deducting these would leave 1,332,503 acres necessary to be acquired by the State for the completion of the park. Provided the State should wish to acquire the main body of land regarded as properly belonging to the Adirondack wilderness and suitable for a forest preserve, the total area would amount to 3,588,803 acres, of which 2,430,941 would be necessary to be acquired by the State.

The report, after presenting a number of very forcible sanitary and economical reasons for the establishment of the proposed park, goes on to say :

"The loss to the State of New York, which would be entailed by the destruction of the Adirondack forests, taking into account the manufacturing and canal interests involved, could only be counted by millions of dollars, and this without taking into consideration the loss to the health of our citizens by the removal of the most valuable of all sanitariums and the destruction of the valuable game preserves of the Adirondacks. . . . The Commission regards it of the utmost importance that the State should acquire title to all the forest lands within the limits of the park, which it is possible to acquire, in the shortest practicable time. It desires further to indicate in the most emphatic way the strong claims that the subject of forest preservation involved in this measure has upon the attention of the legislature, and to urge prompt and liberal action. It is no temporary device that is here under consideration, affecting small interests within narrow limits, but a far-reaching measure, involving the prosperity of the whole State, and having regard to its welfare for all time. On behalf of the people of the State we appeal to you for the immediate enactment of such laws as shall seem to you judicious and effective to save our forests from destruction."

The Commission make a rough estimate of the cost involved in carrying out their proposal, which they think will not exceed from \$3,000,000 to \$3,500,000.

The report, which concludes by recommending a Bill to give legislative sanction to the scheme, contains many suggestions and recommendations in regard to the formation and management of a forest preserve which may be found available for our guidance in dealing with the wooded sections of Ontario, around the head waters of our larger rivers, when we are driven by force of circumstances to adopt a similar measure for their preservation.

FORESTS EQUALISE THE TEMPERATURE.

The *Rapports Annuels de Meteorologie Forestiere*, the leading French authority on the subject, treating of the effect of forests on the temperature, point out that they tend to moderate the severity of heat and cold by equalising the temperature. In a country like ours, where both extremes prevail, according to the season, this is a specially valuable function :

"In a forest the mean temperature is always lower than it is in a denuded country ; but the difference is less marked in winter than in summer ; the maximum temperatures are always lower, and the minimum temperatures are always higher. In a forest the reduction and increase of temperature always advances more slowly ; the temperature there is always more equal in the day, and in the night, between one day and another, and from season to season ; sudden changes of temperature, if they do not last long, do not make themselves felt, from all which we are warranted in concluding that forests tend to keep down the general temperature of a country. On the other hand, they tend to diminish the degree of sudden changes and to avert thunder storms."

FORESTS AND EVAPORATION.*

In view of the fact that the highest scientific authorities are in accord as to the effect of forests in very considerably lessening the amount of evaporation, and so preserving the moisture and mitigating the effect of drouths, and that this opinion is fully borne out by statistics gathered from careful and elaborate observations in different countries, it is somewhat surprising at this late day to see the opposite notion put forward in the name of science by one holding a prominent official position. The utterances of Major Powell, Director of the United States Geological Survey, on this subject have perhaps attracted more attention than their intrinsic merits deserve, owing to their embodying a view so entirely contrary to the generally accepted conclusions of modern climatological research. Owing to the official position which Major Powell occupies, his observations are likely to do a good deal of injury to the cause of forestry by giving countenance to the idea that the clearance of mountain forests is an advantage rather than a detriment to cultivation, and supplying those who are interested in denuding the country with a semblance of argument in favor of such a course.

In the April number of the *Century* magazine for 1890 Major Powell has an article on "The Non-Irrigable Lands of the Arid Region," written with a good deal of descriptive power, and containing much valuable information. While admitting the general importance of forest preservation, both from an æsthetic and utilitarian standpoint, he endeavors to show that "factitious reasons are given which detract from the argument for the preservation of the woods"—having special reference to the point so frequently urged as to value of forests in diminishing evaporation and acting as a reservoir of moisture. On this subject Major Powell says :

"In humid lands, where rivers flow on to the sea because they are not needed on the fields, the problems relating to the streams are of another character. There the floods are destructive, and every condition which favors their diminution is an advantage. Vegetation lives on water. The roots drink it, and the leaves return all that is unused to the air, where it may float away to form clouds in other regions. A vigorous plant will thus evaporate two or three hundred times the weight of its annual growth. Then a great tree spreads, through the agency of its leaves and branches, a vast surface to the air and the heat of the sun. Altogether no inconsiderable portion of the precipitation of a region is thus returned to the heavens, and so fails to find the rivers. The subject has been more or less studied, but it is complex, and the result cannot be simply stated, for the variables are many. Perhaps it is safe to say that from twenty to forty per cent. of the rainfall of a region may be dissipated in this manner. It is manifest that such a loss from the streams is of no small importance in a humid region, and it is for this reason that the preservation of mountain forests in such lands is often strongly urged. But when the streams have a value which increases with their volume, the economic aspect of the problem is at once reversed. Researches on this subject made in the Wasatch Mountains and elsewhere by scientific men show that a great increase in the volume of the streams may accrue from the denudation of the mountains of their evergreen garments. There is still another condition which tends in this same direction. When the mountain declivities are grassy slopes, the snows of winter drift behind ledges and cliffs, and into great banks among the rocks, and they fill ravines and cañons, and are thus stored in compact bodies until they are melted by the summer suns and rains. But when forests stand on the slopes the snows are spread in comparatively thin sheets, and great surfaces of evaporation are presented to the sun and the wind. For all these reasons the forests of the upper regions are not advantageous to the people of the valleys, who depend on the streams for the fertilisation of the farms."

*This article was kindly contributed by Colonel Pearson of Wales, England. His statements may be depended upon, as he was for a long period one of the chief forestry managers in India under the British Government.

The same utterly erroneous and unscientific view is presented in a paper by Major Powell, which appeared in the *North American Review* for August, 1889, entitled "The Lesson of Conemaugh," dealing with the Johnstown flood. In this article Major Powell says:

"In the construction of reservoirs in the arid regions there are important problems not pertaining to humid regions. To a large extent the sources of the water are in high mountains, when the chief precipitation is snow, which, to some extent, stores itself in snow-banks and glacial fields, to be melted by the summer sun at the time when irrigation is required. The upper portions of these mountains are largely treeless—a condition favorable to the storage of snow. In a forest region the snows are evenly distributed over the entire surface, and are quickly melted when the summer rains and suns come; but in a treeless region the snows are accumulated in great drifts in the lee of rocks and cliffs, and under the walls of gorges and cañons. Such great drifts are themselves stupendous reservoirs of water, and artificial works are necessary only to control the flow properly and distribute the water at the places and times needed. Wherever the chief precipitation is snow, forests are a disadvantage if the waters are needed in the valleys below for irrigation, for the forests keep the snow distributed over broad areas of ground, and expose it to the winds on their trunks, branches and leaves, so that altogether the mountain evaporation is enormously increased, as compared with the evaporation from snow-drifts and ice-fields."

In the first place it will be noticed that all this is mere theorising. Major Powell does not attempt to quote even a single isolated fact in proof of his absurd contention. There have been abundant instances in which mountains formerly well-wooded have been denuded of their forest-covering. The effect upon the streams has indeed been marked, but it has been the very reverse of the result which Major Powell's conclusions would indicate. Instead of the volume of the streams having increased owing to the lessening of evaporation it has invariably diminished. If Major Powell had quoted a single specific instance in which the stripping of a mountain slope of its timber had resulted in the increase of the volume of water in the streams fed by the district formerly wooded, his theory might have been worthy of some consideration. But he does not attempt to do so. The facts are too palpably against him. He speaks, it is true, in a very indefinite way of researches made in the Wasatch Mountains by scientific men, showing a great increase in the volume of streams as the result of denudation. But he neither mentions any names, nor gives any details or statistics to corroborate his assertion, which he could very easily have done, if any scientist of recognised standing had made any observations tending to confirm his theory. Considering that Major Powell's view is directly in the teeth of all practical experience and recorded observations of climatologists of note in all parts of the world, his failure to advance a single authenticated fact in support of his hypothesis ought to be sufficient evidence of the reckless, untrustworthy character of his statements. It is extremely to be regretted that mere random assertions, such as those above quoted, lacking even the merit of plausibility, should have obtained widespread circulation, as the official position of the author gives them a factitious and misleading influence.

The weak point of Major Powell's argument is apparent to anyone even slightly versed in the principles of forestry. It is true, of course, that trees and plants give off into the air large quantities of moisture by evaporation. But while emphasising this point, the writer conveniently overlooks altogether the counteracting influence of vegetation in shielding the soil from the fierce rays of the sun and the drying effects of the wind by which the direct evaporation from the ground is immensely lessened. Neither does he take into account the yet more important influence of forests upon the character of the soil itself, increasing its porousness and permeability by a network of roots, and forming by decayed leaves and branches a *humus*, which after every rainfall becomes saturated, and forms a reservoir for the water which would otherwise flow rapidly away. What reliance can be placed in the opinions of a writer on forestry matters who is either so ignorant or so disingenuous as altogether to ignore these most important functions of the forest in its relations to the soil and climate? If Major Powell's unsupported assertion of the effect of denudation on the Wasatch Mountains in swelling the volume of the

streams has any basis of apparent fact whatever, it is no doubt founded upon inability to distinguish between the temporarily increased volume of the streams during the spring, resulting from the clearing of the uplands and the ordinary flow during other seasons. The increased rapidity with which the water flows away in spring after a country has been cleared of its woodlands is a matter of common observation. But this rush of water which swells the streams at certain seasons is always attended by a considerable diminution of the current during the greater portion of the year.

The following, from "A Manual of Forestry" by Prof. William Schlich, Ph.D. of the Royal Indian Engineering College, late Inspector-General of Forests to the Government of India, is a conclusive answer to Major Powell's notion as to the increased amount of evaporation in wooded regions.

EVAPORATION.

Owing to the lower temperature, the greater humidity of the air, and the quieter state of the atmosphere, evaporation must be considerably smaller in forests than in the open. This has been conclusively proved by direct observations. Those made in Bavaria and Prussia show the following results :

Stations.	Quantity of water evaporated from a free surface of water. Height in inches.			Less in forest, expressed in per cent of the total quantity evaporated in the open.
	In the open.	In forest.	Less in forest.	
Bavarian	23.53	8.61	—14.92	—63
Prussian	13.16	5.98	— 7.18	—55
Mean	18.34	7.29	—11.05	—60

These data show that evaporation in the forest was only two-fifths of that in the open country.

The effect of this action is that of the water which falls on the ground in a forest, a considerably larger proportion is secured to the soil than in the open. That water is available to be taken up by the roots, while any balance goes to the ground water and helps to feed springs. Of considerable importance in this respect is the covering of forest soil. Dr. Ebenmayer's observations on this point, extending over five years, show the following results :

Water evaporated from soil in the open.....	=100 parts.
Evaporation from forest soil, without leaf-mould	= 47 "
" " " " with full layer of leaf-mould	= 22 "

In other words, forest soil without leaf-mould evaporated less than half the water evaporated in the open, while forest soil covered with a good layer of humus evaporated even less than one-fourth of that evaporated in the open. The result of these peculiarities is, that, at any rate up to a certain elevation, the forest soil retains, after allowing for evaporation, more water than open soil, although some 23 per cent. of the rainfall is intercepted by the crowns of the trees. In order to illustrate this, the following table, taken from Dr. Weber's calculations, is inserted, as it draws the balance of rainfall over evaporation, according to elevation ; it is based upon the Prussian observations :

Altitude of stations in feet.	Excess of rainfall over evaporation, in inches.		Percentage of rainfall which evaporated.	
	In the open.	In forest.	In the open.	In forest.
0-328	12.02	12.32	55	37
328-656	12.69	13.84	53	30
984-1312	12.20	17.65	58	25
1969-2297	36.96	30.79	22	13
2540	47.10	43.08	15	9
3050	56.77	46.34	19	11

This table shows that the balance of water retained by the soil increases rapidly with

altitude, and that the evaporation in mountain forests may be reduced to about 10 per cent. of the rainfall. If it be remembered that the moisture is most effectually preserved in forests, it will easily be understood why the mountain forests have from time immemorial been looked upon as the preserver of moisture and feeders of springs. No doubt a certain portion of the water is again taken out of the ground by the roots of the trees and evaporated through the leaves. The quantity thus consumed is not known at present, but it cannot be more than 12 inches, the total quantity available in plain forests, and probably it becomes less with elevation, so that a considerable balance remains available in hill forests for the feeding of springs.

MECHANICAL EFFECT OF FORESTS.

The mechanical effect of forests makes itself chiefly felt in regard to the distribution of the rain-water, the preservation of avalanches, and the moderation of our currents.

FEEDING OF SPRINGS AND RIVERS.

Most of the rainwater falling on a bare slope rushes down into the nearest water course in a comparatively short time, thus causing a rapid rise in the level of the stream. Only a comparatively small portion sinks into the ground, so as to become available for the feeding of springs. Of the rain falling over a forest, close on one-fourth is intercepted by the crowns of the trees, and the other three-fourths fall upon a layer of humus, which possesses a great capacity to absorb water and to retain it for a time. It has been shown, for instance, that mosses of the species *Hypnum*, which grew under the shade of conifers, can absorb up to five times their own weight in water, and peat mosses of the genus *Ephagnum* up to seven times, while the leaf mould to be found in a middle-aged, well preserved beech wood can absorb and retain for a time a rainfall of five inches. Part of the water thus absorbed penetrates into the ground, and becomes available for feeding springs, while the rest gradually finds its way into the nearest stream. In this manner, well preserved forests must have a decided effect upon the sustained feeding of springs and the moderation of sudden floods in rivers. When, however, the humus has been saturated with water, and rain continues, the effect of forests as regards inundations must cease, because the additional water follows the laws of gravity and finds its way into the valleys. Hence, the effects are of limited extent, a matter which has frequently been overlooked in discussing the subject. In order to moderate inundations to any appreciable extent, it would be necessary to keep a very large proportion of the catchment area under forest, and even such a measure would only afford protection to a limited extent.

PROTECTION OF THE SOIL.

Water rushing down a bare slope possesses a great mechanical power, by means of which it loosens the soil and carries it down hill. In this way, landslips are often caused, ravines are formed, and fertile land situated at the foot of the ravines may be covered with silt and rendered valueless. Frequently the *debris* collects in rivers and forms obstructions which are followed by a diversion of the bed and erosion of fertile lands. The rate at which this process proceeds, depends on the geological origin and the formation of the surface, the less binding the soil, and the looser the formation, the greater will be the damage. If on the other hand, a slope is covered with a well preserved forest, the roots of the trees, and the layers of humus keep together and protect the soil against the action of the water; besides, the crowns intercept and retain at any rate for a time, a considerable portion of water which reduces its velocity and force, or, at any rate, divide it into numerous small channels. The beneficial effect of tree vegetation in this respect can be observed in most mountain ranges, and especially in the Alps from France to Austria. Wherever in those parts extensive deforestations have taken

place, the consequence has been the gradual formation of a series of torrents in all places where the surface did not consist of hard rock; the *debris* brought down has covered more and more fertile land at the base of the torrents, and this evil has grown to such an extent, that not only in France, but also in the other Alpine countries, great efforts are now made to re-afforest the denuded areas at a great outlay. When once the evil has been created, immediate afforestation is not possible; it must be preceded by the construction of dams, dykes, walls, etc., to steady the soil until the young forest growth has had time to establish itself and once more to lay hold of the surface soil. The importance of maintaining a complete cover of vegetation in all such cases was recognised many years ago, so that already in the middle ages, so-called "Protection Forests" existed, which the then existing laws protected against devastation. Although the effect here described is perhaps most complete in the case of a well-stocked forest, similar effects can be produced by covering the soil in other ways, as, for instance, by a dense growth of heather, by turf, etc.

Forests protect the soil, not only in the hills, but also in the lowlands, wherever it consists of so-called moving sand, along the sea coast as well as in the interior of countries. The action in this case is due partly by keeping the soil together through their roots, by the formation of humus and the retention of moisture. In this way the Landes of France, have, from a dreary waste, been converted into extensive forests intersected by cultivated fields.

PROTECTION AGAINST AVALANCHES.

Although most avalanches in the higher hills originate above the upper limit of tree growth, there are many cases where the presence of a well-preserved forest protects towns and villages lying below them, by preventing the formation of avalanches, or by stopping their forward movement and increase as long as they are yet small. Hence, many forests in the Alps are maintained as a protection against avalanches.

TREES IN CITIES.

Much has been done to beautify and render attractive our cities and towns by the planting of trees on the streets. But much better results would be obtainable if operations were conducted in a less hap-hazard fashion, if more attention were devoted to preserving the trees when planted from destruction, and in particular preventing them being sacrificed to the supposed needs of business or public convenience. It must have been a source of regret to every lover of nature in Toronto, to notice how needlessly and wantonly rows of large, healthy and well-developed shade trees have been cut down on one thoroughfare after another, because they interfered in some slight degree with the laying down of a granolithic sidewalk or a block pavement, or because stores took the place of houses in the neighborhood. In the great majority of these cases, the trees could have been saved by some slight deviation from the hard-and-fast rule of official uniformity and precision. But, no, the terms of the contract must be carried out to the letter, and the trees that have stood for a generation, a joy and beauty to the neighborhood, giving a glimpse of the freshness and bloom of nature amid the city's dust, and roar, and smoke are sacrificed to official stupidity!

Toronto has been, perhaps, exceptionally favored in the past as a city, where a few minutes walk from the business centre in almost any direction will bring you to streets well shaded with trees. But the process of modern "improvement" has been carried on with little regard to the preservation of this attraction, and in the more central parts of the city, the debatable land between the distinctively business and residence localities, the ravage has been great, and for the most part wholly unnecessary. There is no reason why, in widening sidewalks, or laying down new pavements, a clear space should not be left around any trees which stand in the way. A few breaks in the

rigid uniformity of the work would be of trifling importance in comparison to depriving the locality of the grateful shade and verdure of the trees. As to the practice of clearing away the shade trees whenever a street changes its character, and offices and stores take the place of private residences, it is equally stupid and unnecessary. There are, of course, businesses of such a nature that they require a clear frontage such as wholesale warehouses and the larger retail stores upon main streets. But so far as nine-tenths of the business places on the side streets are concerned, the clearance is a wanton, needless act of vandalism, undertaken in deference to a conventional notion that a street planted with trees does not look like a commercial locality. A pleasing exception to the prevalent idea is afforded by the upper portion of Scott street, in the heart of the business centre of Toronto, where contrary to the usual practice, a row of shade trees have been spared—a green oasis amid the surrounding wilderness of brick and mortar, and which affords a grateful rest to the eye, and a refreshing contrast to the lines of bare, unshaded streets around. It is to be regretted that the work of destruction has been allowed to proceed so far without any organized public protest against the official vandalism that is doing much to deprive Toronto of the charm of its well-shaded streets.

In addition to causeless destruction of trees at the caprice of city officials, there are other evils which threaten shade trees in crowded localities which demand more attention from those interested in civic matters than they have received. Prof. H. Marshall Ward, in a recently published article in the *New Review*, deals with the question of how to grow trees to the best advantage in the crowded cities of the Old World. Though his paper deals mainly with conditions which exist here only to a limited extent, it contains many suggestions which might be advantageously studied by Canadian municipal rulers. The writer comes to the conclusion that even in cities like London, Birmingham, Manchester and Liverpool where the atmosphere is polluted with gas and smoke, and darkened with soot and fog, much more might be done in the direction of increasing the number and variety of trees and flowers on the streets. He points out that there is a great difference in the susceptibility to injury from unfavorable atmospheric conditions in the different varieties. Coniferous trees are not nearly so well able to stand these conditions as the balsam poplar, black poplar, alder, sycamore, and some others, nor can the oak, beech, or birch long continue the struggle.

The chief point he wishes to make plain is that, at all events, in the smaller and more open English towns, many more varieties of trees will grow than have yet been tried, and that here, at any rate, "every effort ought to be made to plant some of the many beautiful North American and other foreign trees that can now be obtained, and are known to be capable of easy cultivation in such localities. Moreover, there can be no doubt that much is to be done in this direction in London and other large cities in spite of crowded dwellings and periodical fogs."

Professor Ward then points out some causes for the frequent failure of town trees which do not lie in the unsuitability of atmospheric conditions, and his words show that municipal authorities often work in England pretty much as they do in America. Town trees are "fixed, when young, in a hole, probably filled with good soil, and this is carefully covered in, the young trees suitably staked and protected, possibly the soil round the base of the stem covered with a grating, and the result is—failure! True, it often takes several years to accomplish this striking result, but its inevitableness is none the less assured. While the tree is young, and its root-system is revelling in the pocket of good soil, provided with the overhead grating which ensures a supply of rain-water and air, and it may be of manure also, all goes well, and the head of foliage above is able to make the most of what sunshine there is and to manufacture the substances which supply the wood, new buds, new roots, and, possibly, even flowers. But the time comes when the pocket of soil is exhausted by the roots and they put out spreading threadlike rootlets to explore the soil around. And now comes the critical period; these young rootlets are covered with myriads of extremely fine hairs, and these delicate root-hairs are the only organs which absorb the water containing small quantities of substances such as salts of potash, lime, nitrogen, phosphorus, etc., in solution, and they are utterly incapable of performing this work of absorption in the absence of oxygen. Now, what are

the usual conditions of affairs in the streets of a town? Even supposing these new spreading rootlets have good soil around them, and soil which is porous and deep, the rule is, that a practically hermetically sealed layer of flag-stones or asphalt lies above them, and their only chances of obtaining water and oxygen are through the grating and soil close to the stem. No doubt, the most is made of this, and the tree goes on for several years, doing better than if the flags or asphalt came up close to the stem. How often does it happen, however, that the new rootlets have nothing better to spread in than old brick rubbish or barren gravel; or, far worse, a soil which is saturated with the poison from leaking gas-pipes?"

Even sanitary appliances have an adverse effect upon town trees, for "the neighbouring sewers may be taking off, as fast as they can, the water from soil round the roots; or the case may be otherwise, and the stagnant water, standing too long at the roots of the tree, deprives them of the oxygen necessary for their life and lowers the temperature beyond a minimum they could temporarily withstand. What has been stated so far is enough to show that the wonder is not that trees so often fail in the streets of our cities and large towns, but that the interminable and dreary rows of planes, elms and limes that are planted ever come to anything at all." The author then notes the injuries which may come to town trees through the impact of vehicles, the gnawing of dogs and horses and the pranks of boys, and the danger of selecting, for street-planting, trees which send out long, straggling, superficial roots, running just under the pavement or road, because, as these roots thicken with increasing age, they lift up the flag-stones or other pavement, and, becoming a source of damage and danger to the street, are likely to be injured themselves by passing feet and wheels. The comparative brittleness of the limbs of different trees should also be considered before planting; and, after planting, proper methods of pruning or otherwise treating a tree which is in delicate health or has suffered external injury should be determined.

Although, says Professor Ward, for one reason or another, "the oak, ash, birch, beech and some others of our forest trees are unsuitable for town-planting, this is no sufficient reason for flooding London with planes, and planes only, as if no such trees as robinias, laburnums and American oaks, ashes, walnuts, maples, etc., existed. Moreover, there is every reason to predict success for trees as yet undreamt of as town ornaments. Let those in authority try some of the hardy magnolias—say *M. acuminata*, probably one of the best town trees—and extend their experiments to such as the robinia, the laburnum, the tulip-tree, the mulberry, fig, catalpa and the beautiful maiden-hair tree of Japan. The list might also include the almond, black walnut, and various species of sophora, kolreuteria, cercis, gymnocladus, acer, rhus, tilia, liquidambar, etc. Some judgment would have to be exercised in the matter, of course, but probably all of the trees here mentioned would succeed if properly planted. . . . As regards poplars, ashes, alders, pavia, limes, gleditsia, horse-chestnuts, thorns, etc. . . . I will simply remark that these and many more can be placed in the list of trees and shrubs fit to be planted in large towns and cities; some, of course, are more fit for our cleaner and less smoky country towns, but many would resist the evil influences of a London atmosphere if properly planted and cared for."

According to the United States census returns, Chicago has a total length of 2,048 miles of streets of which 1,200 miles are lined with shade trees. Allowing 528 trees to the mile which would leave an average space of twenty feet between them, this would give a total of 644,600 trees, which at an estimate of \$10 per tree, shows the sum of \$6,446,000 invested in shade and ornamental trees. The trees planted out seldom cost less than \$5 each, and some notable specimens have cost as high as \$50.

An article published in the *Chicago News* gives the following interesting details regarding the planting of shade trees, and the varieties which have been found most desirable for the purpose.

These trees being set out by private individuals, on land invested in the city, are too often allowed to grow without pruning or attention, and oftentimes are not the thing of beauty that they might be if properly attended to. The recent idea of Ald. Vierling of planting and caring for shade trees by public officers would be excellent if one could only

hope that butchers would not be employed instead of foresters. There are many reasons why private effort cannot possibly arrive at the best results. One of these is that each owner acts solely on his own notions and the result is trees from 1 to 2 feet in diameter and 20 to 30 feet high in one place, while right next them are trees not over 10 feet high, then another size and so on.

Another serious difficulty is, one will plant an elm, another a maple, still another an ash. A few will still set out, because they cost next to nothing, a white willow, cottonwood or poplar. Now all these may be good in their way and place, but for purposes of street trees there is nothing gives so much satisfaction as the planting of one kind of tree on a street and reasonably near the same size of tree.

A street to be well treed should have them uniform in size, tall enough for the first set of branches not to interfere with the light from the street lamps and far enough apart to allow sun and wind full play on the streets.

TREES FROM THE WOODS.

Tree planting of early Chicago was almost exclusively confined to what are called soft-wooded trees, like the cottonwood and poplar, that will grow if stuck in the ground as mere poles. The Lombardy poplar was once very common and really the first tree planted of which there is any record, standing in serried rows like soldiers on parade. Some yellow ozier willows and the cottonwood was the sum total planted while Chicago was still but a swamp. An elm was then a rare tree and thought bad to transplant, which it was with the rude methods employed in the work at that time. When a little more care in planting was given, our noble American elm, became the tree, and but for its liability of attack from the red spider in dry times and fungus that browns the leaves it certainly is a grand street tree for a natural soil like that of this city.

Besides the elm, the ash, the linden, a few maples and an occasional birch are those planted from the woods. A good size to plant and one that can be brought into a better uniformity and more certain of success should have a bole a foot from the ground of from 6 to 8 inches in diameter.

NURSERY-GROWN TREES.

With the vast street-tree planting mania of this city there should be a dozen nurseries, each with a good supply of shade trees from 3 to 6 inches in diameter. But there is not, and probably the cause is to be found in the mania for large trees and impatience of waiting for smaller ones to grow. But the fashion in this respect is changing, and lots of people would now buy good nursery trees, if there were only enough of sizeable ones for the purpose. The advantage of nursery-grown trees is clean, uniform, straight boles, with tops in proportion that need no lopping off of branches at the time of planting. Such trees can be easily kept in subjection, so that if planted of one size and one kind of tree in lengths of streets sufficient for effect, there is no reason why the streets of Chicago should not be as attractive as the far-famed boulevards of Paris were under Baron Haussmann.

With the advent of nursery-grown trees we would get the advantage of a greater variety and among them the finest street shade trees in existence. It is scarcely worth while, however, to try these without giving them a better soil than blue clay or lake sand to grow in. As a good tree once planted will last a lifetime even of the oldest a little extra expense in soil should not be objected to.

OF THE MAPLES.

Soft maple should never be planted as street trees. The miserable white cotton scale is bound to attack it every few years and while it may not kill outright, when so attacked it is a nuisance hardly bearable. Wier's cut-leaved maple is a more ornamental tree and seems to escape the scale. The hard maples, including the scarlet and sugar maple, are

splendid street trees, but to do well must have good, loamy soil. The English and Norway maples are the best of all, the leaves being larger—almost like a sycamore—and on high, gravelly ground are simply faultless as street trees. One good feature about the hard maples is that they do not grow out of shape and straggly—at least not until they get very old.

THE ASH AND THE LINDEN.

Ash make fair street trees—shade not too dense, which is of great importance, and is one reason why large-leaved trees are better than very small-leaved ones. This is well illustrated by that noble tree, the buttonwood, which unfortunately, although making so good a street tree in St. Louis, for example, is of no use for us.

The American linden is of goodly size in the leaf, a compact grower and well adapted for a street tree. Plants raised in a nursery have stems as straight and clean as a whipstock. Its flowers also diffuse a delightful fragrance for a few days. It bears transplanting well, and is not so particular as to soil as some trees.

BIRCH AND ELM.

Birch is hardly the thing for street trees, but for a single specimen on the lawn they are grand, particularly the cut-leaved variety. These belong to the small-leaved trees, and the shoots are a dense mass of twigs. It is a tree that bears trimming famously, so that it can always be kept within bounds. Good examples of trees kept pruned may be seen on Drexel boulevard.

For a majestic tree, standing out all alone where its branches have full sway, the American elm has no equal. As a street tree, planted as they are with us from the woods, they are rarely of a uniform growth. Some have nearly upright branches, others almost drooping. Still, take it all in all, save for the summer browning of the leaves, it makes a grand street tree. Of the European varieties there are not enough grown to have had a good trial as yet.

THE ASH-LEAVED MAPLE AND CATALPA.

Negundo, or ash-leaved maple, is not infrequently planted, and sometimes can be seen in pretty outlines. But it is not a good street tree, its shade being far too dense. Besides, from some cause or other, its foliage often gets in bad shape toward the end of summer. They were very bad in South Park last summer.

From its very large leaves the catalpa is an attractive tree, but more suitable for a lawn than a street tree, although some few have been planted for the latter purpose. The only one that will stand our climate is the speciosa, which is a native of Illinois and Missouri. The southern species first planted here could not stand our climate.

THE HORSE CHESTNUT.

The horse chestnut, that does so well for a street tree in the east, is useless for the purpose here. While it may not die, its growth is so provokingly slow that it takes a lifetime to get it to twenty feet in height. The American buckeye, while of no use for a street tree, is an admirable inside low tree, lovely when in flower.

OTHER KINDS THAT HAVE BEEN TRIED.

In wandering about the city one may come across other varieties that have been tried on a small scale, but they are hardly worth imitating. The white willow is one, but it is too littery a tree for the present day. Of the golden willow there are a few left, but it is a gnarly, crooked, useless tree. A few silver-leaved poplars may be seen, but they are fit only for the wilderness. The bird cherries have been tried, but they are too small and of no particular value. The alder is another that is of no use except for a wet spot.

PRACTICAL FORESTRY ON A SMALL SCALE.

It is perhaps unfortunate that the term forestry in its general acceptance has come to signify the preservation of a due proportion between wooded and cleared land over a large tract of country. Those who take any interest in the matter at all are apt to think of it as a science intended in its practical application to bring about far-reaching and general results on a grand scale in the modification of the climate and the conditions of the soil, and to lose sight of its bearing upon the concerns of the individual farmer or land-owner. They do not understand that the same principles of forest management, which brought to bear over an extensive region will result in safeguarding the interests of the future and securing the national prosperity, will if applied to the individual holding, prove of material advantage. Neither does the management of a farm in accordance with the principles of forestry necessarily involve a present outlay in the hope of a return on the investment in the more or less distant future. In fact in many cases it need not entail the labor and expense of replanting. Where there is still a portion of the farm under timber, the farmer can apply forestry principles to its management to his great pecuniary benefit simply by judicious selection in cutting and protecting the young trees from the inroads of cattle.

Forestry is simply the art of making the land devoted to wood-production yield as much as possible to the acre, and by intelligent care providing for the perpetual reproduction of the crop. Its practice demands no elaborate scientific study or technical knowledge other than that gained by observation from a common-sense point of view. The farmer who wishes to preserve his timber with an eye to the future, will readily understand the wastefulness of promiscuous chopping on land not intended to be thoroughly cleared and turned to account for agricultural purposes. It needs no book learning to teach him that the economical and prudent course is to thin out such spots as may be overcrowded, so that some of the trees have not space to attain their full development, and thus leave the remaining timber room to grow; or that in case the woods are already thinned out sufficiently the proper policy is to take a tree here and there, choosing the oldest or those of the least valuable varieties instead of narrowing the limits of the woodlot by making a clearance in one place.

By a little thought and prudence in this matter the farmer can continue to draw his supplies of fuel from his corner of bushland without diminishing the source of future supply, and in a corresponding degree depreciating the value of his farm. But if in addition to this he sees fit to plant valuable varieties of timber the demand for which is certain to increase, even though he may obtain no direct money return, the value of the land will be augmented year by year with the growth of the young trees.

On many farms there are waste and barren patches wholly or partially cleared which not being good agricultural land are non-productive, excepting in so far as they are utilised as pasture-land. If these were planted, or even enclosed, and allowed to grow up in second growth, they would in a comparatively few years prove a valuable source of revenue. What can be done to utilise such spots is shown by the following notable instance taken from the columns of *Garden and Forest*, a New York publication. After speaking of the numerous cases in which untillable land was allowed to lie waste, and pointing out that by permitting timber to grow up such areas might be a source of profit to the owner, the writer, Mr. H. B. Ayres, goes on to say:

One such lot, which seems characteristic, was found in Warren County, New Jersey, in the Pequest Valley and is a fair example of what may be expected on muck land that produces only sedge-grass and wild rose-bushes when cleared and pastured. Some of the notes of most general interest are here given. The soil is muck, from one to four feet deep. The subsoil is drift redeposited by a post-glacial lake near its eastern shore, and consists of sand and clay irregularly bedded, with some "hard pan." A spring brook flows through the tract. The surface of the water in the brook is above the surface of most of the subsoil, and supplies the soil with abundant and constant moisture, except during unusual drouth.

Prior to 1858 this lot of seven acres has been continuously depleted of tree-growth and burned over. At this date a few defective trees, say twenty, were standing, with about half of the tract in coppice of maple and ash, the remainder being occupied by sedge-grass, rose-bushes and scattering seedlings. The whole young growth was then cut off, and during the next ten years it was burned over every spring to reduce it to pasture. In spite of the fire and pasturing, the young growth gradually developed into a complete cover. The maples, starting freely among the sedge-grass, were at first eaten off by the cattle, but dense clumps and belts of rose-bushes annoyed the cattle, and, finally, with blackberry vines, formed so dense a hedge near the adjacent cultivated land that the cattle seldom penetrated into the young growth of trees.

The last places to be covered were two very wet spots (where the seedlings at last started on decayed logs, sending their roots down a foot or two to the soil, as the logs rotted away), and the higher ground that was never overflowed. The latter was most grazed by the cattle, and was only covered by seedlings after the cattle were hedged out. The trees are thus not all of one age; some are from the seed, others are sprouts from the small stumps left from browsing. The trees near the "fail places," or those places last covered, started up very limby, and are now very much shorter than those densely grown from the first. The species found on this lot were red maple, black ash, swamp white oak, pin oak, sycamore, white birch and white elm. The red maple is throughout the most numerous, and in the parts most subject to overflow is only accompanied by a few ash and elm. The oldest of the trees are now about thirty years, and the youngest fifteen years. The greatest space between trees is twenty-five feet and the average is about seven feet.

The growth on the whole tract is vigorous, and the crown cover is very nearly complete. The trunks of the best trees are free from live limbs to a height of thirty feet above the ground, and are now nearly smooth, though a few dead branches are still adhering near the lowest live limbs. Many inferior trees are dead and sickly from overcrowding, but the remainder will be the better for their death. All the leading trees are vigorous. It is noticed that the white birch and swamp white oak are rapidly overtopped and killed by the red maple. The elm holds its own with difficulty, while the ash, in damp spots, where there is more space, seems to equal the maple, and will eventually overtop it.

An area was selected that seemed to represent fairly the average of the whole tract. The measurements on this acre showed the average to be as follows: Number of trees per acre, 901; height, 48 feet; diameter, 6 inches on stump, and 5 inches breast-high; contents, 4.1 cubic feet per tree, or 3,685 cubic feet per acre; merchantable wood, 3.4 cubic feet per tree, or 30.6 cords per acre.

TABLE OF GROWTH.

No. of section.	Dist. from ground.	No. of rings.	Diameter.
	feet. inches.		inches.
No. 1	8	24	6
No. 2	4 8	22	4 $\frac{1}{8}$
No. 3	8 8	20	4 $\frac{1}{8}$
No. 4	12 8	19	4 $\frac{3}{8}$
No. 5	16 8	16	4
No. 6	20 8	15	3 $\frac{5}{8}$
No. 7	24 8	13	3 $\frac{1}{2}$
No. 8	28 8	11	3
No. 9	32 8	9	2 $\frac{5}{8}$
No. 10	36 8	8	1 $\frac{7}{8}$
No. 11	40 8	5	1 $\frac{1}{2}$
No. 12	44 8	3	1 $\frac{1}{8}$
No. 13	48 8	1	1 $\frac{1}{8}$

The value of this land at the time attempts at clearing were abandoned in the year 1868 was not more than ten dollars per acre. To-day the market value of the wood-growth alone is \$30 per acre.

The reader will observe that in this case all that was done was to leave nature to do the work of re-forestation unmolested. If in addition the owner had chosen to re-plant, choosing the best, most profitable or quickest-growing kinds of trees, the value of the timber would have been far greater.

There is a suggestion for Canadian farmers as to a profitable source of revenue in the following. Post material is continually growing scarcer in Ontario, and before such a crop could arrive at maturity the price is certain to be considerably higher than at present.

Mr. Waldo F. Brown writes to the *Country Gentleman* that the black locust can be profitably planted for posts, at least in Ohio. He asserts that farms have been sold there at from \$20 to \$30 an acre, which, if planted in locust-timber, would yield several hundred dollars an acre in posts within twenty years, and then would make a second harvest quicker than the first grew. He cites an instance of a ten-acre grove which was cut off between 1860 and 1870 and then sold for posts. How much this first cutting brought could not be ascertained, but it was certainly profitable. In just eleven years after the present owner began to sell posts from the second growth, and he has since had a regular income every year. Between 1879 and 1883 he cut 6,608 posts from the ten acres which brought \$991, or an average of fifteen cents a post, and ever since then he has cut and sold large quantities. For ten years past this land, which is a steep hill-side unfit for cultivation, has yielded more profit than the remaining ninety level acres of the same farm which have been under cultivation. In another case a row of thirty-three locust trees, which had been planted along the north line of a farm for twenty rods, was cut after having grown twenty-five years. The harvest was 400 good posts, worth twenty-five cents, 600 fence-stakes, worth five cents each, and enough wood to pay for cutting and splitting the posts. From the second growth of this grove the owner has cut all the posts needed to keep the fences on his farm of 150 acres, and he has now 200 posts seasoned for future use. These trees occupy only a quarter of an acre of land. How long one planting of locust-timber will continue to yield crops no one knows. As soon as a grove is cut off it begins to send up a new crop, which grows rapidly, and will be large enough for post timber some years sooner than such timber could be grown from seed. Mr. Brown once examined a grove of two acres on which the trees had been cut eleven years before, and found that each stump had thrown up from three to seven sprouts, the largest of which were then being cut. This thinning process went on for several years, until all but one of these sprouts to each stump was cut, and then enough trees were left to make a dense forest. In the thirteenth year after the original cutting 400 posts were cut from two acres.

It is in the line of urging individual effort and acquainting the masses of the people, more especially the farmers, with the rudimentary, common-sense principles of managing timber-producing land or land that should be devoted to that purpose, that forestry will for some time to come find its principal sphere of utility. On this phase of the subject we cannot do better than quote the following from an able paper read by Mr. Gifford Pinchot at the latest meeting of the American Forestry Association :

"The spirit of the recent Swiss forest-legislation is one which must permeate our own coming forest-laws if they are to win that acceptance with the people without which they must be worse than useless. It has been summarised as follows by Professor Landolt : 'Our forest-laws are intended to work more through instruction, good example and encouragement than by severe regulations. This method is somewhat slower than one which should involve more drastic measures, but the results achieved are more useful and lasting. When forest-proprietors do something because they are convinced of its utility, it is done well and with an eye to the future ; but what they do under compulsion is done carelessly and neglected at the first opportunity. What they have come to learn in this way, and have recognised as good, will be carried out, and that better and better from year to year.' This homely statement of the great Swiss forester is full of the wise moderation of a man conscious of the dignity of his work. Successful forest-reform, here as there, must be a growth from the education of the people, finding its expression in laws which respect both the needs of the forest and the needs of the people, and which waste no

time in mistakes. Such legislation is respected, because it is capable of being enforced. The results of it are so large, it is so surely a part of the future, that the friends of forestry in America ought to work for it with the steady vigor of men who know they are going to win."

THE TREES OF BRITISH COLUMBIA.

Mr. Julian Ralph, an able American writer, in a paper descriptive of the great natural resources of the Province of British Columbia, gives an interesting survey of the forest products of our Pacific domain, and the growing timber industry of that region. From the following extract it will be seen that the forests of British Columbia differ very greatly from those of Eastern Canada in their characteristics. It is to be hoped that these vast sources of national wealth and prosperity just being opened will not be wasted as recklessly and improvidently as has been the case in other portions of this continent. The British Columbians should learn from the experience of older-settled communities which are now undergoing the disastrous consequences of indiscriminate forest destruction, and not wait until the greater part of the mischief has been done before taking measures to preserve the sorry remnant of their forest wealth.

"I enjoyed the good fortune to talk at length with a civil engineer of high repute who has explored the greater part of southern British Columbia—at least in so far as its main valleys, waterways, trails, and mountain passes are concerned. Having learned not to place too high a value upon the printed matter put forth in praise of any new country, I was especially pleased to obtain this man's practical impressions concerning the store and quality and kinds of timber the province contains. He said, not to use his own words, that timber is found all the way back from the coast to the Rockies, but it is in its most plentiful and majestic forms on the west slope of these mountains and on the west slope of the Coast Range. The very largest trees are between the Coast Range and the coast. The country between the Rocky Mountains and the Coast Range is dry by comparison with the parts where the timber thrives best, and naturally the forests are inferior. Between the Rockies and the Kootenay River cedar tamaracks reach six and eight feet in diameter, and attain a height of 200 feet not infrequently. There are two or three kinds of fir and some pines (though not very many) in this region. There is very little leaf-wood, and no hardwood. Maples are found, to be sure, but they are rather more like bushes than trees to the British Columbian mind. As one moves westward the same timber prevails, but it grows shorter and smaller until the low coast country is reached. There, as has been said, the giant forests occur again. This coast region is largely a flat country, but there are not many miles of it.

"To this rule, as here laid down, there are some notable exceptions. One particular tree, called there the bull-pine—it is the pine of Lake Superior and the East—grows to great size all over the province. It is a common thing to find the trunks of these trees measuring four feet in diameter, or nearly thirteen feet in circumference. It is not especially valuable for timber because it is too sappy. It is short-lived when exposed to the weather, and is therefore not in demand for railroad work; but for the ordinary uses to which builders put timber it answers very well.

"There is a maple which attains great size at the coast, and which, when dressed, closely resembles bird's-eye maple. It is called locally the vine-maple. The trees are found with a diameter of two and a half to three feet, but the trunks seldom rise above forty or fifty feet. The wood is crooked. It runs very badly. This, of course, is what gives it the beautiful grain it possesses, and which must sooner or later find a ready market for it. There is plenty of hemlock in the province, but it is nothing like so large as that which is found in the East, and its bark is not so thick. Its size renders it serviceable for nothing larger than railway ties, and the trees grow in such inaccessible places, half-way up the mountains, that it is for the most part unprofitable to handle it.

The red cedars—the wood of which is consumed in the manufacture of pencils and cigar-boxes—are also small. On the other hand, the white cedar reaches enormous sizes, up to fifteen feet in thickness at the base, very often. It is not at all extraordinary to find these cedars reaching 200 feet above the ground, and one was cut at Port Moody, in clearing the way for the railroad, that had a length of 310 feet. When fires rage in the provincial forests, the wood of these trees is what is consumed, and usually the trunks, hollow and empty, stand grimly in their places after the fire would otherwise have been forgotten. These great tubes are often of such dimensions that men put windows and doors in them and use them for dwellings. In the valleys are immense numbers of poplars of the common and cottonwood species, white birch, alder, willow, and yew trees, but they are not estimated in the forest wealth of the province, because of the expense that marketing them would entail.

“This fact concerning the small timber indicates at once the primitive character of the country, and the vast wealth it possesses in what might be called heroic timber, that is, sufficiently valuable to force its way to market even from out that unopened wilderness. It was the opinion of the engineer to whom I have referred that timber land which does not attract the second glance of a prospector in British Columbia, would be considered of the first importance in Maine and New Brunswick. To put it in another way, riverside timber land which in those countries would fetch fifty dollars the acre solely for its wood, in British Columbia would not be taken up. In time it may be cut, undoubtedly it must be, when new railroads alter its value, and therefore it is impossible even roughly to estimate the value of the provincial forests.

“A great business is carried on in the shipment of ninety-foot and one-hundred-foot Douglas fir sticks to the great car-building works of the United States and Canada. They are used in the massive bottom frames of palace cars. The only limit that has yet been reached in this industry is not in the size of the logs, but in the capacities of the saw-mills, and in the possibilities of transportation by rail, for these logs require three cars to support their length. Except for the valleys, the whole vast country is enormously rich in this timber, the mountains (excepting the Rockies) being clothed with it from their bases to their tops. Vancouver Island is a heavily and valuably timbered country. It bears the same trees as the mainland, except that it has the oak-trees and does not possess the tamarac. The Vancouver Island oaks do not exceed two or two and a half feet in diameter. The Douglas fir grows to tremendous proportions, especially on the north end of the Island. In the old offices of the Canadian Pacific Railway at Vancouver are panels of this wood that are thirteen feet across, showing that they came from a tree whose trunk was forty feet in circumference. Tens of thousands of these firs are from eight to ten feet in diameter at the bottom.

“Other trees of the province are the great silver-fir, the wood of which is not very valuable; Engleman's spruce, which is very like white spruce, and is very abundant; balsam-spruce, often exceeding two feet in diameter; the yellow or pitch pine; white pine; yellow cypress; crab-apple, occurring as a small tree or shrub; Western birch, common in the Columbia region; paper or canoe birch, found sparingly on Vancouver Island and on the lower Fraser, but in abundance and of large size in the Peace River and upper Fraser regions; dogwood; arbutus; and several minor trees.”

THE FOREST OF FONTAINEBLEAU.

An interesting description of the famous French forest of Fontainebleau, notable for its historic no less than its artistic associations, lately appeared in the *St. Louis Globe-Democrat*, the following extracts from which convey a clear idea of the difference between the carefully managed forests of the old world and those of America, where the natural growth has been uninterfered with.

The popularity won by the paintings of Millet, Rousseau and others of the Barbizon school has called public attention to the famous forest of Fontainebleau and the wealth of artistic material it is supposed to possess. Artistic writers as a rule do nothing by halves, and it is therefore not surprising that enthusiastic devotees of the new school of nature, as represented by the two great painters whose names have been already mentioned, should be thrown into spasms of admiration at the bare mention of Barbizon and Fontainebleau. It is the centre of the new "return to nature," and therefore represents to the worshippers of nature what the lakes of England typify to admirers of the Lake School of poetry.

To him who has contemplated forests such as are found in America the forest of Fontainebleau is a great disappointment. In the first place, it is not, in the strict sense of the word, a forest at all, but a carefully preserved and, in many places, an exceedingly artificial park. Its extent is considerable, being about sixty-five square miles, but aside from a few hills here and there of no great elevation, its surface is comparatively level. In some places, occasional masses of stone crop out, the size of the blocks being from 20 to 50 feet in height, and the irregularity of the masses giving a certain picturesqueness to the locality, which without their presence would be lacking. Large oaks are found in abundance, some of them being, it is believed, from four to five centuries old. There are also other forest trees, of species common to France, but the forests have been preserved with an eye to effect; the landscape gardeners are constantly passing to and fro, ascertaining where they may make changes for the better, planting here, felling there, with a constant eye to effect.

The landscape gardener and woodsmen are, therefore, largely responsible for the appearance of the forest. It is a forest in the sense that there is an abundance of trees, but the wildness, the naturalness of a genuine forest are utterly lacking. Hundreds of little paths wind to and fro through Fontainebleau. Thousands of sign-posts are set up, bearing directions to the pedestrians, and few indeed are the ways he can tread without meeting frequent signs of civilization. There is no undergrowth, except in spots where it has been carefully planted. There are no dead branches cumbering the ground; all these are daily removed. There is no evidence of the neglect, the desolation which prevail in a natural forest. Many of the trees show careful signs of pruning, and everywhere the observer is impressed with the artificiality of the landscape before him.

When compared with the Yosemite Valley, with the Yellowstone Park, with the grand forests of the Upper Missouri, with the cañons and gorges of Colorado, with the wild prospects of Montana and Dakota, or even with the swamp scenes of Louisiana and Florida, the forest of Fontainebleau dwindles into insignificance. The works of art will not bear comparison with those of nature, and even the neglect and prodigality of nature are more admirable than the most scrupulous care which evinces the presence of artistic design.

Less than fifty years ago the Fontainebleau Park became suddenly fashionable as a resort for artists. It was a place where they might admire nature in an enthusiastic kind of way, without taking too much trouble. They loved nature, no doubt, but not so enthusiastically as to be willing to take much pains or go to much expense in order to gratify their longing for the wildness of natural scenery. Nature is seen in savage abundance in Norway, but the mountains and fjords of the Scandinavian coast are distant many days' journey from the nearest seaport of France. Switzerland has scenery, but climbing is troublesome work, living at Swiss chalets and hotels is expensive, and even the nearest part of Switzerland is hundreds of miles from Paris. The Spanish Pyrenees, where nature may be seen in her wildest glory, are not readily accessible, while the Black Forest, a forest in reality, is in Germany, and for a long time it has been contrary to French principles to admire anything German.

The forest of Fontainebleau had every advantage. It was entirely French; being only thirty-five miles from Paris it was easily accessible. An artist could spend a day there and return to his quarter in the Quartier Latin easily and quickly. It was, beyond all things, natural enough to suit the aspirations of painters who preferred nature with a few embellishments added to her countenance. So Fontainebleau became the fashion. A few leading painters made it such, and in France, especially, to be out of fashion is to be out of the world.

THE RELATION OF FORESTS TO CIVILISATION.

The following paper from the pen of Hon. Warren Higley, a former President of the American Forestry Congress, on "The Relations of Forests to Civilization," brings out very clearly the economic aspects of the question, more especially in relation to the effect of forests upon the water supply. With the rise of great cities the securing of an adequate supply of water to satisfy the continually increasing needs of the centres of population has become one of the most urgent problems of the time. Sources of supply once thought to be copious have in dry seasons been found to be insufficient on account of the greatly diminished yield of the streams and springs, owing to deforestation on the one hand and the considerably augmented necessities of the population on the other. As Mr. Warren's paper shows, the effect of the destruction of the forests about the head-waters of the streams which supply New York and Philadelphia with water, has been to seriously threaten the people of those cities with a water famine. Their experience should be a warning to Canadians of the evils at present generally unforeseen which may result from the reckless and wholesale destruction of our forests.

Whatever contributes to the necessities of man, and through him to the strength and greatness of the nation, becomes an important factor in civilisation. We study with profound interest the progress of the intellectual development of the race from the remotest dawn of history to the present time.

The epics of Homer, the philosophy of Plato, whose writings Emerson says "embody the wisdom of the world," Virgil, Dante, Shakespeare and Goethe, give expression to the highest intellectual developments of their times. Scientists, discoverers and inventors have enabled man to utilise the forces of nature toward the progress and civilization of this nineteenth century. But without the necessary physical conditions and environments a nation cannot maintain her superiority, however eminent may be her men of letters and science.

The foundation of continued and lasting national prosperity lies in the physical condition of the country, with reference to its healthfulness and productiveness. A prosperous nation cannot be built up in a desert, nor can a people continue in power and influence when the territory from which they draw their sustenance shall have receded into barrenness, and while this is undoubtedly true of nations as a whole, it is proportionately true of any portion of the nation's domain.

Through the beneficence of forests and vegetable growth the earth was prepared for the habitation of man; and the carbon imprisoned in vegetable fibre from the ambient air was stored in exhaustless beds for the use of teeming millions when the forest supply should become inadequate to their wants. A requisite proportion of forest area is necessary to the continued prosperity and highest development of a people.

EFFECT UPON THE WATER SUPPLY.

The water supply of our large cities is one of the very difficult problems with which our growing municipalities have to wrestle.

The accessible rivers and springs and lakes that a few years ago were thought to be sufficient for a century have already, in many instances, so diminished during the dry season as to seriously threaten a water famine, with all the horrors which such a catastrophe would entail.

THE SCHUYLKILL.

For several years past the engineers of the water works department of Philadelphia have been making examinations of all possible sources of a suitable and adequate supply of water, and they have recently discovered how seriously the Schuylkill river, from which the city has ever drawn its supply, has been affected by the clearing of the forests from

the territory of its head waters and supplying streams. Sixty-five years ago the summer flow of the Schuylkill was estimated at 500,000,000 gallons per day. Measurements made from time to time showed a gradual diminution, until in 1874 the minimum summer flow was only 250,000,000 gallons per day, and this has greatly diminished since. This fact is well authenticated, and it is clearly evident that these changes have been effected by the gradual deforesting of the country from which the head waters and supplying streams were fed.

The forests act as a sponge, absorbing and holding the waters in the loose vegetable mold or duff and shallow swamps, to be given slowly out in the dry season. They hold the snows of winter until late in the spring, and thereby tend to check destructive floods; and with their leafy covering they prevent the rapid evaporation which dries the open fields under the summer suns.

THE CROTON.

Only a few weeks ago New York was threatened with a water famine, notwithstanding the great tunnel that taps Croton lake forty miles away and absorbs the available streams and springs in the whole Croton water shed. This section of the country had experienced a long continued drouth. The largely deforested region from which the river draws its supply was unable to hold back the floods of spring and the rains of summer to any considerable extent, and what remained the evaporation of the open country largely exhausted.

Were a large and adequate proportion of this water-shed densely forested, a constant water supply for the city of New York would be assured even through seasons of long continued drouth.

Where will New York's water supply come from in the year 1900, when her population will aggregate 5,000,000 souls within a radius of thirty miles from the City Hall? In less than fifty years at her present rate of growth New York city with Brooklyn and the same territory will support a population of 10,000,000. Then she will have to tap Lake Champlain.

CENTRAL NEW YORK.

Let me give you an example of the effects of cutting of the forests in a rural district in Central New York, drawn from my own observation and experience. In Cayuga county streams that forty years ago kept the ponds well filled for the saw-mill and grist-mill, and furnished a never failing supply of water for the farm, are now dry in summer, with the exception of here and there a stagnant pool; the dam is decayed and washed away, the mills gone, and the once picturesque scene is changed to that of desolation. Yet with the warm rains of spring and melting snows the streams overflow their banks, and the swift waters carry away fences, bridges and embankments. Spring opens later. The young cattle were wont to be turned into the wood-sheltered pasture about the 1st of April, now they are kept shut up until the middle of May. Peach orchards that were sure to be loaded every year with luscious fruit have almost disappeared, and the crop is the exception rather than the rule. The extremes of heat and cold are greater, and drouths in summer and floods in springtime are more frequent and more destructive. Trace the stream to its source, and the cause of these things is apparent. The old tamarack swamp that used to supply the boys and girls with aromatic gum, and in which the creek had its beginning, has all been cut away. The thickly wooded black ash swamps through which the stream ran in its course to the lake, have been cleared, and their marshy, areas have given place to cultivated fields and pastures.

The cutting away the forests from the head waters and the banks of these streams accounts largely for the changes I have noted, and this picture, I doubt not, is a very familiar one in central and western New York. It is not difficult for those who know the effects of stripping the forests from small areas around the head waters of the smaller streams to understand why summer navigation in the Mississippi, the Missouri, and the

Ohio has become difficult and at times impossible, where it was easy and constant a few years ago; or why the Hudson, the Mohawk, and the Genesee are so much lower in summer and higher in spring than in former years. The partial deforesting of the Adirondack region has sufficiently demonstrated the fact that were this great water-shed stripped of its forest covering, the Empire state would lose her prestige, and New York city her rank as the first commercial city of the new world.

ECONOMICS.

The study of political economy is demanding very general attention. An increasing interest is manifested in all the economic questions immediately affecting the ruling industries. Supply and demand, governing price and wages and the character of citizenship are the balance wheel of trade, and demand the most careful scrutiny of the business world to so adjust them as to prevent oppression and insure the general good. Labor organisations on the one hand and trusts organisations on the other, are zealously contending for larger and surer incomes. Capital and labor fail to harmonise, and many a battle will have to be fought before the rights of each and the mutual interdependence shall be recognised and respected. The adjustment of apparently adverse interests between capital and labor is necessary to public prosperity—and must come through the better understanding of economic questions.

But what we should war against is the useless destruction and waste of our forest wealth that has so generally prevailed. Forest fires that should have been prevented have annually destroyed millions of acres of valuable timber in New Jersey, Pennsylvania, Michigan, New York, in all parts of the Union, and in many of the mountainous regions the very soil that covered the rocks has been burned away, and centuries must elapse before the sheltering forests can again clothe them.

In the census year of 1880 Professor Sargent estimates that 10,274,089 acres of our forest area were burned, involving a loss of \$25,462,250. He says in his published report that fire and browsing animals inflict greater permanent injury upon the forests of the country than the axe, recklessly and wastefully as it is generally used against them.

What our best civilisation demands, in my opinion, is the establishment of a wise and efficient forestry administration in every state of the Union, whereby the great water sheds of our important rivers and streams, and all mountainous and broken areas unfitted for agriculture, or that may be necessary to the public welfare for climatic and hydrographic reasons, shall be forever devoted to forest culture, and to supplying the growing demand for wood and timber in our various industries.

It is a mistaken notion that prevails, that lumbering necessarily destroys the forests, although so far it generally has. On the contrary, lumbering conducted according to the principles of forestry, as in Germany and France, protects and improves them. The large and ripened timber is removed for market, and the smaller growth is thereby enabled to develop because of better light conditions and suitable care.

Forestry, like agriculture and mining, is a business, and when better understood will command equal attention, and be recognised as a factor that enters largely into the more immediate economic questions of the day.

MONETARY VALUE OF OUR FOREST PRODUCTS.

The annual product of our forests constitutes one of the most important factors in the nation's wealth. Viewed simply from its monetary value, it ranks third in the great industries of the country, manufactures of all kinds being first and agriculture second. Dr. E. J. James, of the University of Pennsylvania, a distinguished political economist, gives a vivid picture of this portion of our nation's wealth, in a comparison of values of forest products with those of other industries, based upon the census reports of 1880. He says:

"The value of the forest products in that year (1879) was equal to one-third of that of all products whatsoever sold, consumed or on hand. It exceeded by nearly one hundred

million dollars the total assessed value of all the farming property in the New England states, and by a somewhat smaller figure that of the farms of Virginia, North and South Carolina, Alabama and Mississippi.

"If to the value of the total output of all our veins of gold, silver, coal, iron, copper, lead and zinc, were added the value of the product of stone quarries and petroleum wells, and this sum were increased by the estimated value of all the steamboats, sailing vessels, canal boats, flat boats and barges plying in American waters and belonging to citizens of the United States, it would still be less than the value of the forest crop by a sum sufficient to purchase at cost of construction all the canals, buy up at par all the stock of the telegraph companies, pay their bonded debts and construct and equip all the telephone lines in the United States.

"This sum of \$700,000,000, the value of the forest product of the United States for the year 1879, exceeds the gross income of all the railroads and transportation companies in the United States, and if we leave out New York and Pennsylvania it would suffice to pay the public indebtedness of all other states in the Union, including that of all the counties, townships, school districts and cities within those states."

Since 1879 there has been a large increase in the consumption of our forest products, and at a very conservative estimate their monetary value has grown to exceed \$800,000,000 year per.

That so vast an interest has an important bearing upon our prosperity and development as a nation no one will deny. But great as this interest is as an economic factor in our civilisation it is small in comparison with the influence of growing forests upon climate and water supply, upon agriculture, commerce and manufactories and health conditions for the people.

Time will not permit me, in this brief paper, to multiply examples illustrative of this assertion. But the fact is conceded by scientists who have most carefully investigated the subject, and confirmed by history, as we have seen, that a country whose hills and mountain sides are stripped of their forest covering becomes thereby incapable of sustaining a prosperous and civilized people.

Must we then cease to cut the timber and market the forest product in order to preserve the conditions necessary for successful agriculture and water supply and river commerce? This we cannot do. Wood and timber are greater necessities than coal and iron; and while the fact remains that the present consumption of the forest product is double the increment of its growth in this country, and that the original growth of some of our most valuable woods, like the white pine and the black walnut and cherry, is nearly exhausted, we have large reserves of other woods to take their places on the markets. We need have no fears of a lumber famine, with the facilities of commerce now encircling this globe.

What we want especially is a more enlightened public opinion on this subject. It takes a hundred years to grow a magnificent forest. Let us be patriotic and foresighted, and plant and legislate for the future.

We cannot live and prosper as a nation without a due proportion of forests, rightly distributed. They constitute our great sanitariums. The pine forests of the south, the wood-covered mountains of North Carolina, the Adirondacks, invite the invalid to recuperation and health.

The forests protect and regulate the water supply, add beauty to the landscape, and break the force of the cyclone.

The forests restore waste places to fertility and productiveness, and contribute of their bounty to the mechanical arts and industries millions of wealth annually.

I have thus endeavored to establish what I believe to be true, that in their various aspects the forests constitute the greatest factor in our civilisation.

WILLOWS AS SHADE TREES.

The willows are among the most useful trees we have for farm ornamentation ; especially good for busy people like the working farmer and his family, who want beauty but can devote only a small portion of the time in the busy season to tree planting. All varieties of willows will grow from fresh cuttings driven in the ground in a moist place, These cuttings may be of any size, from the small switches to straight branches as large as can be handled. Those about the size of bean poles seem to flourish best. Small ones grow well enough, but are more liable to injury. They are not particular about soil, provided they have plenty of water, but of course will grow faster in rich earth. In a wet season they will grow from cuttings stuck down anywhere ; but if wanted for a place that becomes very dry in summer they had better be rooted first. One of the finest avenues of trees the writer ever saw was of willows, grown from cuttings, planted in holes made with a crowbar. The season was favorable, and in a long avenue planted in this way only two failed to live. The owner cut the poles from a neighbor's trees and set them out at a total cost of only half a day's work. They are now lofty trees meeting over the road, and people turn out of their usual course for the pleasure of driving under them. It was the best half day's work that man ever performed. Avenues as a rule look best when all of one species, but a favorite way of planting is to alternate the weeping willow (*Salix Babylonica*) with the golden-branched willow (*S. vitellina*), the growth and colors contrasting well. "A willow walk," made by planting osier willows (*S. viminalis*) thickly on both sides of a straight, level path is always admired and can be made profitable, too, if there are any basket-makers about. If it is laid out so as to show a view of water at the end it may be made especially attractive.

Willows are among the first trees to put forth their leaves in spring, and the last to shed them in autumn. They harbor few insects, and grow rapidly. The wood is too soft to be particularly valuable as timber, but does for light fires, for charcoal, and many other purposes. The trees are bright and cheerful when young, and assume rugged and picturesque forms as they grow old. The limbs are sometimes broken by high winds, but they recover rapidly from injury and submit to the severest trimming without serious impairment. There is nothing unhealthful in the proximity of the trees although they, or any other trees, should not be planted where their shade will fall directly on dwellings. Where small trees are wanted there are some dwarf or shrublike species of great beauty to use. There are perhaps thirty kinds, altogether, adapted to ornamental planting of home grounds as well as public parks. With suitable ground a single specimen, especially of some of the weeping or drooping varieties, will make a showy and graceful ornament. Two or three or more, planted in a clump, give a pleasing effect.—*John De Wolf, New York.*

CALIFORNIA TREES.

The subjoined article from the Providence (Rhode Island) *Journal* comprises some valuable information with regard to the trees of California. The "giant trees" have been often described, but as will be seen there are many other varieties of forest growth peculiar to that locality which are almost equally remarkable. It is a matter for regret that many of these unique and beautiful species are threatened with extinction owing to the policy of reckless clearance and the greed which leads to the destruction of valuable timber for a slight immediate profit without consideration for the needs of the future. The manner in which these grand forests are being ruined by promiscuous cutting is the strongest possible argument for strict measures of forest preservation. Unfortunately the wasteful process of cutting down valuable trees merely for their bark and leaving the trunks to rot on the ground, or furnish the fuel for forest fires, is by no means confined to California. It is too often practised in our own back townships. Stringent legislation is needed to repress such vandalism.

To the forest Rambler California opens a new field of interest. Its forest flora is quite distinct from that of the rest of the world; and the general appearance of the Californian woods is altogether different from that of any forest elsewhere. One of the points attracting curious consideration in our forest is the number of trees restricted in their native habitat to a few acres of ground and found naturally nowhere else on the globe. Who has not heard of the giant Sequoia? Who has not heard of its girth and its grandeur, of its wonderful bark like the velvet of Lyons, and the towering stretch of its arms to the azure? These big trees, together with a number of other species, now only found in California, were once widely distributed. Fossil remains of some of them have been found even in the frozen soil of Greenland. Their extinction in other parts of the world seems sadly enough to be their destiny in California. The condition which is preventing, in all probability, their reproduction, is a progressive diminution of humidity in the air. One rarely sees a wild seedling Sequoia of either variety, a seedling Sugar Pine (*Pinus lambertiana*) or Monterey Cypress (*Cupressus macrocarpa*). This is also true of the Torrey pine, the Wild Cherry of Catalina, and of many of our trees and shrubs; while on the other hand there is a strong reproductive power in others of the California trees such as the Douglas spruce, Monterey pine, several of the oaks, etc.

Several groves of the Sequoia Gigantea or Big Trees are found in California. This great tree is now native to only California, and in this State is confined to one range of mountains, the Sierra Nevada. The largest grove is a true forest, and lies back of Fresno in the Southern Sierra.

The largest tree in the world has only recently been found. It is a Sequoia Gigantea and measures 160 feet in circumference at the highest point a man can reach from the ground. This tree stands in a small valley surrounded by precipices at the headwaters of the Kaweah river.

Perhaps the tree that combines best beauty and grandeur is the brother of the giant Sequoia, the lovely and impressive Redwood. The Sequoia sempervirens is confined also to one range of mountains, the Coast Range near the Pacific Ocean. While vast forests of it exist and to-day form the lumber resource of California, the Redwood is not reproducing itself, but is being replaced as it is cut and burned away by other and less notable trees. It has one very exceptional trait for a conifer which is doing much to retard its disappearance. The Redwood sprouts from the cut stump and makes a numerous progeny to replace the grandeur of the parent used by the lumber pool. The vitality of the Redwood stump is paralleled by the Redwood log. I have heard of several striking instances of these logs sprouting long after having been cut, and have seen one instance myself. It was a very large log, weather-stained and lying on two or three others in a narrow valley of the Santa Cruz Mountains. From this log were two bright little branches of Redwood foliage, one about two feet long and the other six inches. The log had been cut three years. This quality would indicate a facility for coming from the cutting which would be useful in replanting the desolated lumber districts.

The Coast Range forests are full of interesting trees. One of these is the Madrona-*Arbutus Menziesii*. Its leaf is glossy, reminding one of the magnolia, and its bark a dark red except when at certain seasons the old bark is shed; it is then white. The Madrona bears red berries, and in the damp cañons of the Coast Range, where it is at its best, is certainly a beautiful addition to the more sombre Redwoods.

The long-coned spruce of the Sierra Madre strays down the hot southern slopes of this steep range and even joins hands in the cañons with the more adventurous sycamores coming up from the valleys. This spruce may play an important part in retimbering some of our uncultivable foot-hills. It is a beautiful tree when mature and equally attractive when young. In Southern California it is at once the victim and the ornament of our Christmas festivities. The California Holly (*Heteromeles arbutifolia*) suffers also most in man's moments of merriment. Its red berries and serrated leaves are very ornamental. We have the English holly in a few mountain localities, but not sufficiently accessible to be much used.

One of the most beautiful of our native trees is the wild cherry of Catalina (*Prunus occidentalis*) confined in its native habitat to that island. It is a beautiful tree of dense dark-green foliage and glossy leaves, reminding one from a distance of a perfect orange tree.

The Lawson Cypress, so splendid and so useful a timber tree in damp soil, is perhaps the most attractive of the evergreens; but it is not suited to all or even many places in the south.

When one commences a conscientious compendium of the beautiful trees of California the deserving aspirants crowd so fast around one that the task, to be properly performed, must be so unduly lengthened out as to be quite unmanageable in an article of this kind.

The oaks are well represented in California, and extend from the high Sierras to the bluffs by the sea, as at Santa Barbara. Of these the two most useful for timber are the *Quercus Garryana* and the *Quercus oblongifolia*. The rest of the family are now used mainly for fuel; but with the better information as to the treatment of the wood, and the season at which it should be cut, many of our oaks will certainly be found otherwise useful. The *Q. lobata* is the large oak common in the central valleys of the State. It is often a great tree and picturesque; but it is, in my opinion, never a peer to either the Golden Leaf Cañon or Iron Oak (*Q. chrysolepis*) of the north, or of our Red Live Oak (*Q. agrifolia*) of the south. Both these trees have at once a friendly dignity and a beckoning beauty that suggests on the one hand ancestors and respectability, and on the other picnics and love scenes.

There are two immigrants of the family that do remarkably well here, the English Oak and the Cork Oak. The latter is a good grower in Southern California, and the great commercial value of its bark should increase the planting of this tree. The gathering of the bark does not injure the tree, so its value on waste places is certain and of indefinite duration. In this respect it differs from our native tan-bark oak, the bark of which is so well known in commerce. This tree is cut down and stripped of bark, and the wood left to rot, or worse—to feed the flames that may thus gather force to destroy the young trees that would replace those cut. This oak is fast being exterminated, and as its wood brings the highest price in the northern markets for fuel it is an illustration of the waste now prevalent in all timbering and forest methods in this State.

There is one other tree whose treatment in this State distresses both the sentimental and the reasonable person. It is that splendid giant of the forest the sugar pine (*Pinus Lambertiana*). This tree is the largest pine tree of the whole world and a most valuable timber tree. It is distinguished by its sugar-like gum on wounds, by its long spineless cone, by its graceful habit, its great height and by its growing in forests of other trees and not in solid groves all its own. One of the peculiarities of this tree is the free splitting quality possessed by a certain proportion of them, but not by all. Taking advantage of this the shake-makers eke out a poor subsistence by tramping through the Sierras and felling every grand sugar pine they come across. Some split well; a few lengths of these are used, but thousands upon thousands of feet of clear lumber are left to rot and feed the flames. Some do not split well; and these are left entire, a menace to their fellows of the forest, and a source of sorrow to the sagacious. The shake-maker like the tan-bark gatherer is a trespasser, a violator of law and a thief of the public property. These two are the authors of the grossest waste in our forest exploitation.

Coming back to the pines we find this family in California exceedingly interesting. There are to start with more species on the Pacific Coast, and more in California, than in any similar area in the world. The Pacific Slope has twenty-three species, California eighteen, and there are besides ten well-marked varieties. We have the largest pine tree in the world, probably also the smallest, the one with the largest cone, the one with the smallest, the best nut producers, and the only pine with its foliage growing as solitary leaves instead of in bunches. Several of the species are only found in very restricted localities, as the Torrey and the Monterey pine.

If it were not for the Sugar Pine we would still have the finest and grandest pine tree of the world in the *Pinus Ponderosa* or Yellow pine. This tree extends throughout the mountain region of California, and with the Incense cedar and Douglas spruce forms the coniferous forests on our own southern mountains.

The Pinon Pine, the Digger Indian, the Coulteri, or big cone, all with large, sweet, edible seeds, grow in our driest and hottest foothills, and with the Juniper and Mesquit hold out a hope for turning much of our deserts to use. This latter tree has a gum similar to gum arabic, which it is now used to adulterate. It has also an edible seed much used by the Indians and Mexicans both for themselves and for their stock. Its wood ranks above oak for fire wood, and is practically indestructible in the ground. Of all trees in the world it has the widest range, extending from the deserts and plateaus east and west of the Sierra and Rocky Mountains through Mexico, South America, and crossing the Andes is found still in La Plata and Bolivia. It comes from the seed easily, and under favorable conditions makes reasonably rapid growth and a fine, good-sized tree.

And still we have said nothing of the California Laurel, our native and fragrant bay, whose wood is now so valuable for cabinet work; nothing of our alders, ashes, maples, firs, poplars, willows, cottonwoods, sycamores, walnuts, and other interesting trees, nor can we within these limits.

The *Scientific American* has the following additional details on the subject relating more particularly to the famous big trees of California. It will be seen that had it not been for the timely action of the United States Government in setting apart national parks the magnificent forests of the *Sequoia gigantea* would in a very few years be completely destroyed. It is to be hoped that the threatened fate of the remaining giant trees will be averted by the extension of the reserves so as to include much of the territory now being devastated by the wholesale destruction of these forest wonders:

In some twenty irregular groups, extending through a distance of about two hundred miles on the western slope of the Sierra Nevadas, from Calaveras through Tulare County, California, are found what are known as the famous "big trees" of California, one of which form the subject of our illustration, and, wonderful to relate, although a passage-way has been cut through it through which stages regularly pass, the tree still lives. This tree is in the Mariposa grove, and is 28 feet in diameter. A still larger tree in the same grove is known as the "Grizzly Giant." It is 34 feet in diameter. The highest of these trees is in the Calaveras grove, and is 325 feet high.

This tree, the *Sequoia gigantea*, should not be confounded with the California redwood, *Sequoia sempervirens*, a tree which quite frequently reaches a diameter exceeding 15 feet and a height of 300 feet. The largest specimen of this tree is seven miles south of Santa Cruz; it is 20 feet in diameter and 366 feet high. The redwood is found from the boundary of Mexico northward, forming vast forests upon the Coast Range of mountains, never very far from the Pacific. The wood is light and close grained, much resembling red cedar in appearance; it splits with remarkable facility, is eminently durable, and is used for building purposes, cabinet work, and almost every variety of general wood work, forming the principal staple of the California lumber trade.

With such abundant supplies, therefore, of one of the finest varieties of lumber, it seems something more than a pity, but rather a matter calling for severe criticism, that the lumbermen should be permitted to destroy, as they are doing, with a few exceptions, these groves of *Sequoia gigantea*. These trees grow nowhere else in the world, and their beauty, grandeur, and marvelous age combine to make them objects of such surpassing interest that the folly and neglect of the government in permitting their present destruction will pass the comprehension of succeeding generations. The Calaveras grove, north of Yosemite valley, is still untouched, and the Mariposa grove, thirty-five miles south of the valley, is safe, because included in the Yosemite grant, but the Fresno Flax grove, the next one in the belt, is a scene of destruction. It belongs to the California Lumber Company, of San José. Their policy has been to slaughter the trees without regard to age or size, beauty or grandeur. This was once one of the most beautiful of the groves,

but to-day it is a pitiful wreck. Giants of the forest, fifteen, twenty, and thirty feet in diameter, lie on the ground in every direction. The largest trunks, those that are too large to be handled easily with the saw, have been shattered with blasting powder. Stumps of the trees, six, ten, or a dozen feet high, are all about, an army of witnesses to the malevolent avarice of men. Occasionally there is a mighty tree still standing, with a great gash, perhaps five feet deep, cut and sawed into one side. This grove has been almost annihilated. When the company cleans up the trunks and limbs that now cover the ground, its work of destruction will be just about completed. It has been engaged on this grove for a number of years, and has turned its attention almost entirely to the sequoias.

If the big tree lumber brought higher prices than any other sort, the zeal which is shown in the destruction of the groves could be understood. But it rates no higher in the market than the sugar pine, with which the mountain slopes are densely covered. The lumber companies could have made just as much money and been at no expense for blasting powder if they had let the big trees alone and turned to the sugar pines.

In the groves further south the same scene is repeated time after time. In that portion of the sequoia belt between the north and south boundaries of Tulare County alone there are at least ten mills, every one of which is industriously working away at the big trees. Their owners evidently fear that the national government will some day awaken to the wisdom of throwing protection around these unique groves, and they are determined to get just as much money out of them as possible before that day comes.

In the Fresno grove, which is on the line between Fresno and Tulare Counties, the General Grant National Park preserves a few of the big trees. It is only a square mile in extent, and does not include the whole of the grove. The rest of it is rapidly disappearing. A little to the southeast the Sequoia National Park includes the North Kaweah and South Kaweah groves, which were withdrawn from sale in time to save them from destruction. Through the remainder of the groves one comes upon the same scene again and again. Everywhere axe, saw, and blasting powder are doing their detestable work with speed and thoroughness.

It has been proposed to extend the boundaries of the Sequoia Park so that it will embrace all the sequoia groves in Tulare County and cover the mountain slope from the summit of the Sierras nearly to the lower timber line. If the proposition included the whole belt of the sequoias from the most northern grove to the most southern tree, it would be still more heartily approved by all those—excepting, always, the mill-owners—who have visited the groves and know how hopeless is their preservation in any other way.

CLIMATIC CHANGES.

It has been a matter of common observation of late years that the climate of the North American continent is undergoing a radical change. There are various opinions among scientific men as to the causes which have produced this result. The following article on the subject by Mr. E. B. Dunn, which appeared in the *New York World*, will be read with interest, as in addition to embodying his theory of the cause, which may or may not be sustained by further research, it gives some important facts and statistics, showing the extent of the alteration in meteorological condition. As will be seen, Mr. Dunn attributes the change mainly to the extent to which irrigation has been carried in portions of the "American Desert," creating a moisture in large atmospheric areas, and thereby deflecting the storm centres from their former course. If his hypothesis is sound, it is probable that the process of deforestation has had not a little influence in causing the change, as the forests have much to do with regulating the distribution of moisture.

There seems but little doubt that the climate is undergoing a change. For ten years the seasons have blended so gradually that no definite line has marked the outgoing of one or the incoming of the other. The winters, if we may call them such, have been mild and snowless, save with rare exceptions; while our summers, that formerly sent joy to our seaside and country resorts, now stand as history, and leave a sad remembrance of "what might have been" had not the seasons changed.

Numerous theories have been advanced to show a reason for the change. Some are without foundation, others have many plausible phases. The oldest inhabitants, looking back over their boyhood days, tell us that they can bring to mind cold winters and great snowstorms, covering a period of months, when the bare ground could not be seen and the sleighbells jingled from November to March. All these old fellows declare that certainly the climate is changing.

There are strong adherents of the claim that the Gulf Stream, pressing nearer to our shores, has caused the difference in our climate. They say that if the Gulf Stream didn't warm up the British Isles they would be as cold as Greenland. This is very doubtful, according to scientific investigations made by Mr. M. J. Thoulet. His researches prove that when the stream reaches the vicinity of Newfoundland, the depth and volume are no longer sufficient to exert any material action on the climate. This indicates that the old theory of the Gulf Stream being the only cause of the mild climate of the British Isles (if these investigations be correct) must be discarded and the real cause sought elsewhere.

This theory can, in no sense, apply to the change in our climate, for the reason that as yet we have no tangible proof that the Gulf Stream has changed its course, and if it has, it could not, in any sense, affect the climate of this country. Its waters may literally wash our shores, and yet the change would not be perceptible even in the coast States. For all storms and atmospheric phenomena pass from west to east. And the prevailing direction of wind being off shore, the winds would necessarily carry any change that might occur into the ocean.

Again, the rotation of the earth is a most important factor to prevent weather conditions travelling to the westward. These facts alone are sufficient to dispel the Gulf Stream theory.

Furthermore, the change in climate has not been of local nature, but has been as great or greater in the central valleys and extreme west as in this vicinity. Even the Southern States have, and are still undergoing considerable change. They no longer have their mild winters, as in former years. High pressure areas have followed each other in rapid succession into that vicinity, and caused the temperature to remain below the freezing point for periods equal in duration to some of the more northerly States.

In all the years since 1885, with but one exception, the climate in this vicinity has become gradually warmer. The following figures from the records of the Weather Bureau prove this. The annual mean temperatures show the total amount of heat received, and are best calculated to make the case plain, and are, moreover, trustworthy :

ANNUAL MEAN TEMPERATURE.

1885	49.8
1886	51.0
1887	51.9
1888	50.0
1889	53.5
1890	53.6
1891	53.8

The year 1888 was not only exceptional as to the order of steady change in temperature, but its eccentricities took form in especially rough storms and the blizzard of March.

The excess of heat for 1887 amounted to 212 degrees. There was, too, a surplus of 3.14 inches rainfall.

The year 1888 closed with a deficiency of 452 degrees and a surplus of 9.17 inches of rainfall. That year, with but one exception, is the wettest on record.

The year 1889 almost doubled the heat lost during the previous year. At the close of December there was an excess of 845 degrees of temperature, and a surplus of 15.15 inches of rainfall. This exceeded that of 1888 by 5.98 inches, and is the heaviest amount recorded by the Weather Bureau in any one year.

The year 1890 made a still greater effort, and piled up 918 degrees mean temperature above the normal. It was also a very wet year, and closed with 8.76 inches of rainfall above the average.

The year 1891 ended with an excess of 586 degrees mean temperature, but was deficient 3.81 inches in rainfall.

The most remarkable feature, as shown in this excess of heat, lies in the fact that it was gained during the fall and winter months, while the summer months were cooler than the average. Many days of December, January and February have been warmer than a great many in June, July and August. This has been so frequent as to cause general comment.

The cause for such a change is not easy to trace, and all theories and deductions advanced to solve the problem can only be verified by a long series of observations, covering a number of years. It is necessary to start from the birthplace of storms that cross our country. The climate of some particular place must be determined by the number of storms and the passage of the storm centres to the north or south of it. If the storm centre passes to the north of this city, for instance, the warm southerly winds flow to the northward over us, but should the centre pass to the south the cold northerly winds would rush towards the centre, and consequently give us colder weather. The winds from all sides continue to flow towards the storm centre to fill the vacuum, and as they do so they blow spirally inward and upward, according to the movements of the hands of a watch. The winds from an area of high pressure have a diametrically opposite movement, and are thrown off from the centre, thus producing the colder weather when the centre is to the north of the given place, and warmer weather when south of it.

The prevailing conditions depend entirely upon the duration of these centres in passing as well as their frequency. Therefore, as the effect is apparent and well established, we must trace these disturbances to their birthplace to locate any change in their development or course. If we can assign any reason or show a cause why they should take a different course across the country than travelled in previous years, it is one step nearer solving the problem.

The storms that cross this country, or the majority of them, develop in the extreme north-west, beyond the limits of our country, or pass in from the North Pacific Ocean. Others, again, develop in the extreme south-west, or come in from the South Pacific. Very few cross directly over the central mountain districts. The storms that move across the mountain range, by the time they reach the eastern side, are almost entirely without precipitation. All the moisture they start with (which must be considerable to give them energy enough to cross the mountains at all) has been deposited on the west side, in consequence of the warm moist air meeting with the colder upper currents. For the winds are forced to a much greater height than would otherwise be the case. Therefore, by the time they reach the east side of the mountain they are dry. This accounts for the arid lands of the west. In nine out of every ten storms I find the movement of the storm centres towards the central plains on the east slope of the Rocky Mountains, whether they come from the north-west or south-west. They linger in that neighborhood, apparently with but little energy at first. Finally they develop and take a north-easterly course across the country.

Storms, like a current of electricity, follow a course of the least atmospheric resistance. Of this we are fully aware. Then why should most of the disturbances move into and over a country where the air is dry, and the greatest possible resistance is encountered, instead of moving off in a natural path? Because the land that was once an arid desert is to-day skilfully manipulated in a scientific way, so that 4,300,000 acres of land in Colorado, Nebraska, Wyoming and Utah are under a state of cultivation by artificial means. Irrigation has done for the central plains what nature has failed to do. It is

this great spreading of water over such a vast territory—this putting of an oasis in the desert—that has been the attraction to draw and assist in the development of storms in that vicinity. Thus they have been brought from a southerly into a more northerly course, leaving the great lakes the next nourishing place in a natural course. Thus the storm centres that in former years passed eastward over the central or Southern States and then up the Atlantic, find a much easier course over the lakes and down the St. Lawrence Valley. The high pressure areas then sweep to the south behind the storm, causing “northers” in Texas and colder weather during the winter months in all the Southern States. What remains of such cold waves after the centres of high pressure get to a position where we can get that portion of the wave which is due us is hardly perceptible. I cite, for instance, the year 1889, where twenty-nine storms crossed the country, twenty-eight of which passed to the north of this city and but one to the south. This of itself accounts for our warm winter of that year.

Now, we ask, is this state of affairs to be permanent? I am inclined to believe that if the theory advanced is correct and is really the cause of the change—and it seems in every way plausible—then the change has come to stay, so long as New Mexico, Arizona and Texas are left without irrigation. Just so soon as these States are irrigated the storms that come in or develop in the south-west will follow a course more towards the nearest watercourse, which is the Gulf of Mexico, thence across the Gulf or Southern States and off the Atlantic coast, drawing down the cold wave as in former years and bringing our climate into its natural seasons.

FACTS ABOUT TREES.

White oak timber is valued in shipbuilding.

Apple is excellent for food and fuel. Weaver's shuttles are made of the wood.

Of dogwood, weavers' spools and handles of carpenters' tools are made.

The wood of the American aspen or white poplar is used in the manufacture of paper.

Mountain laurel wood is used in making combs. The leaves are poisonous to some animals.

White ash is used in carriage works. It is poisonous to snakes. It is said a snake is never found in its shade.

Black birch timber is used in basket works, and that tree is claimed by the Indians as their natural inheritance. It emits a pleasant odor when burning.

The butternut is a tree that likes best a rocky, uneven soil, and in whose shade neither shrub nor herb will thrive. The bark is used as a dyestuff for woollens.

Curled and bird's-eye maple is a wood of the same family that sometimes have curiously arranged fibre, one with curves, the other with eyes, hence the name.

Black wild cherry timber is much valued in cabinet works. The bark is highly medicinal. The leaves when wilted are poisonous to cattle.

Witch hazel is a large and curious forest shrub. The small branches were formerly used for “divining rods.” And an extract from it is valued in medical practice.

ADDRESS ON THE VALUE AND USES OF FORESTS.

The following address was lately delivered by Mr. R. W. Phipps to the students of Upper Canada College, and as it embodies the general principles of forestry it has been considered well to print it in this report:

It will be, of course, impossible in one short lecture to exhaust this subject. But, perhaps, we shall be able to make it sufficiently interesting for this afternoon, by attempt-

ing an abridgment in which it will be endeavored to give a clear idea in succession of the principal points of forest value. The first is .

HOW MOISTURE IS RETAINED IN FORESTS.

The whole forest, in its natural state, forms a reservoir admirably fitted to receive large supplies of moisture, to hold it for a lengthened time, and to part with it at intervals well calculated to benefit the vegetation of the surrounding country. The bed of the forest is a widely spread surface, piled thick with leaves, twigs, pieces of fallen branches and remnants of decayed logs, covering another layer of the same substances, in a state of partial decomposition, overlying yet another strata completely decomposed, altogether forming a deep porous hollow framework, penetrated with a myriad of pipes, tubes, and aqueducts, and interspersed with millions of miniature cisterns. Then, every hollow on the surface is obstructed by fallen and rotting logs, clogging and holding in position the flow of water until the humus below fully absorb it, while the whole surface of the earth is crossed, recrossed and crossed again by a chequer-work of partially elevated roots, the box-like openings between which perform the same function. If we go below the surface, we shall find the solid earth beneath the mass of vegetable decomposition pierced everywhere with upright and porous pillars of wonderful tubular structure—the large and perpendicular tap-roots which many trees possess, passing deep into solid clayey strata otherwise impermeable, and sending through the triturated earth which surrounds them, a slow and steady supply of water to a thousand subterranean and spring-feeding channels, which travelling away from the forests and under the cultivated fields, supply the great lower bed of moisture that is continually rising, fertilises the upper soil, and finally passes off to find in brooklet, lake or river, their course to ocean again. On this great natural bed and reservoir, rain may fall in torrents, only to be held there in suspension till it gradually, and in such degrees as are best fitted to promote the beneficent work of nature, flows away in curving creek, in rippling rivulet, nourishing and feeding the thirsty earth as it goes. On this same great bed, vast mountains of winter snow may pile themselves, protected by the overhanging branches and dense thickets of underbrush, against too rapid thaws in spring, thoroughly moistening and soaking the whole great mass of humus and roots, and furnishing a vast field for evaporation ready to part with its watery treasures to the surrounding atmosphere, at the fervent bidding of the warm sunbeams of April or May, the period when vegetation needs them most—the period for which nature has stored them, and at which she delivers them, and the period, if you notice, at which she takes care no dense foliage obstructs the action of the sun. Then, reversing the process, when in times of drouth, the forest bed has parted with its surface treasure of moisture, the deeper roots can and do draw from the subterraneous and concealed channels, a vast supply for the trees themselves, which again passes through the leaves into the air and falls in rain or dew.

MOISTURE SUPPLIED TO THE AIR BY FORESTS.

The forest land being always shaded by the dense masses of foliage above, from the summer sun, is then much cooler than the surrounding earth of the open country, a coolness increased by the damp atmosphere within and surrounding it, produced by the exhalations of the leaves, by the droppings of the great accumulations of dew, which collect on its great extensions of leaf surface in the course of the night, and by the evaporation from the ground itself, which, as before observed, is almost a perpetual bed of moisture. The amount transpired by the leaves, as shown in the preceding paragraph, is enormous. The forest then, is continually sending out and sending upwards, dense accumulations of vapor. It necessarily sends them upwards, the vapour of water being the lightest and most inclined to rise of all vapours. Therefore, there will be above the forest a large stratum, or it may be a column of air holding in solution as much vapour of water as it can bear without forming a cloud, and thereafter in due time to be precipitated in rain. What may occasion this we will speak of further on.

MOISTURE INCREASED BY PREVENTION OF WINDS.

Another cause which adds to the moisture in the fields surrounding a forest is the great influence it exerts in modifying the force of the wind. When the stratum of air immediately above the field has, in drying the fields, taken up a portion of its moisture, that moisture will pass off slowly to the stratum of air above, and that in turn to the next above; but if the stratum of air next to the ground be rapidly moved across the ground by the wind, it is no longer simple evaporation into one stratum, that portion of stratum moves off immediately with the wind, and is immediately succeeded by another portion of the same stratum, and that by another and another as rapidly as they can pass over the ground, each in turn taking what moisture it can rapidly imbibe. Therefore, a portion of country protected by an adjoining forest from rapid winds, may remain, although exposed to sunshine for weeks, in good moist and growing condition, while a rapid drying wind passing over it for even one day might have taken from the ground much more moisture than it could spare, and have very injuriously affected the crop. To prevent this is one great use of even very thin lines of trees.

ACTION OF FORESTS IN DISTRIBUTION OF RAIN.

To understand this, we will glance at the structure of trees. We will notice that in the first place these receive their nourishment from the roots, this passes upwards to the leaves, the vehicle which carries it up being water, which, having discharged this operation is largely thrown off from the leaves in the form of vapour. Much fresh nourishment is also received through the leaves, mingled with that which has ascended from the roots, and both together are then distributed through every part of the tree. But what we have to notice here principally is, that the great quantity of moisture necessary as a vehicle passes away from the leaves into the atmosphere. The quantity so passing from a forest is immense, forming a great body of vapour heavily charged with moisture continually rising to the clouds.

We will now notice that the supply of moisture for the world comes principally from that vast volume of vapour which rises from the equatorial ocean belt, and passes away on each side to the north and south poles. This is a much warmer body of vapour than that arising from the forests, and wherever these two meet, precipitation naturally occurs and showers of rain are the result. Where no forests exist rain is produced by other causes, such as the mingling of the polar and equatorial currents of air, but in these cases rain falls in heavy torrents. The value of the forest in this, is not so much that it increases the quantity of rain, as that its action tends continually to distribute it in fertilising showers instead of heavy falls. A valuable writer on the forests of Maine thus exemplifies the matter:

First, Trees shade the ground and thus prevent the sun from parching away the water contained in the ground, which accordingly stands its chance of ultimately reaching mill wheels. Our forests being for the greatest part evergreen, shade the ground at all seasons. They check, therefore, the waste of winter snow as well as the waste of summer rain. Nothing is more common than for patches of ice formed of solidified snow, to be found lying here and there in the defiles and ravines of our woods as late as early June, saturating the ground about them in their melting and sending off streamlets to the nearest brook, lake, or river.

Forests check the movement of the atmosphere, both the horizontal and the vertical, one or the other of which is always in circulation, and thus prevent or diminish the removal of moisture from their area of occupation by the connective power of the winds. This is a circumstance of great importance, as may be inferred from the rapidity with which the roads dry up, or clothes from the laundry dry off during the prevalence of wind. Our woods being so largely evergreen check the movement of the winds at all seasons, and abate evaporation therefore at all seasons, a matter of some consequence since evaporation goes on from snow and ice, and from water at all temperatures, and is accelerated by wind from four to ten fold, as experiments show, and according to circumstances whatever the temperature may be.

In the fourth place, forests roughen and break up the ground through which their roots force passage so that water can penetrate it ; and so that in innumerable depressions and sinks formed by the heaving ground over the roots, its volume when in surplus can be husbanded against too sudden removal. This is especially important upon hilly and mountainous watersheds contributing to their uniformity of discharge.

Lastly, as was observed in the section on mountains, forests cover the ground beneath with masses of vegetable matter which holds water like a sponge, and thus favor the uniformity of the volume of the connected rivers.

The combined and last result of all these influences is to increase the amount of water that shall, other conditions favoring, be available for manufacturing. The further result is to regulate the supply or delivery of the water, in which respect the function of forests is probably of not less importance than in regard to the volume of water. In one word, forests contribute in a very important measure to the two prime essentials of water power, namely, its volume and constancy, their influence in this respect being exceeded by only that of lakes and surface materials.

In the next place, I must mention when I speak of a forest, I do not wish to be understood as speaking of a level sward of close bitten grass. Over such a surface the rains fall and flow away as over a barren field. To allow forest ground its benefit to the surrounding country, it must be allowed its opportunities of indulging in undergrowth. If necessary, cattle must be kept completely out from the circle of the forest, in order that the young trees may spring up. For, it will be very plain to you, that if no young trees arise the forest cannot be perpetuated. What we need in a forest which is to serve its proper purposes, is a continual succession of bright undergrowth, concerning which, the great law, the "survival of the fittest," shall give us a succession of younger trees ready to take the places of those which are mature and are properly cut down and used. But it should be here remarked, that if tolerable pasture be allowed outside, cattle will never injure a forest.

A grove may be very well established, so that at all hours of the day cattle will find shade around its edges without being allowed to enter within its bounds.

And now I will enter upon another form of forestry. I want to impress upon you the idea which doubtless many of you comprehend already, the idea which is largely practiced in many lands, that of forming plantations of trees. We have been so much in the habit in these northern countries of relying on the original forest which now is fast leaving us, that it is time we noticed what is done in other lands. Large spaces of ground are chosen and planted with trees. In the first place, the ground must be so thickly planted with young trees as to shade the soil. In the next place, these young trees at the proper time must be so thinned out as to allow the ultimate trees room to grow. The reason of this is, that if we planted at first isolated trees, they would grow to branches and form nothing but knotty timber, while, if we grow them close together they will form tall upright columns of clear wood. Therefore, if you try plantations, grow your trees as closely together as nature will permit.

If the question be what trees may most beneficially be planted, the answer is, that if we plant the walnut we cannot expect good merchantable lumber until sixty years. The cherry or the hickory will give you valuable lumber in half the time, the pine in fifty years. Nearly all others in thirty years. All these seem long spaces to look forward to ; but it must be remembered that the land is always the more valuable for having them upon it. I may instance here one grove which I have examined in Illinois. It has been planted in walnut for forty years, it is but fifteen acres in extent. The owner of the farm said to me, "My farm is nearly four hundred acres, but in twenty years that walnut grove will be worth three hundred thousand dollars, and will be worth more than all the rest of the farm.

I would like here to emphasise the benefits to be gained by planting rows of trees on the exposed sides of farm lands. In the first place, we need shelter from the winter winds. All of us are aware how desert and bleak it is to travel or to live in our northern climate when the forest has been cut away. Rows of trees properly planted can easily remedy this. And for these purposes, I would recommend the evergreen rather than deciduous trees. Rows of the Scottish larch or of the Norway spruce, or perhaps,

best of all, of our own Canadian pine will answer well. I would recommend that these rows be double instead of single, the double rows to be fifteen feet apart. Undoubtedly some land would be lost by this process, but all loss will be more than repaid by the increased comfort of the residence and by the increased fertility of the land.

Men of our Canadian race, in whose strength we trust that a great Canadian empire yet shall stand, I ask you, preserve the trees, plant them as windbreaks around your farms, plant them in plantations near your house, let the branches wave and let the glad foliage of each succeeding spring say that they are there and that you are of them. If you wish near your residence that which shall arouse in you great and noble ideas, then have near you a grove of trees. In the absence of all other companionship, their companionship is perpetual. The wood, the whispering tenants of the grove, will always please you, will always, however desolate the world may seem, convey contentment to your heart. Finally, do not, I ask, make of your lands a waste of sand or clay. Give the trees a proper place; let them be, as they will be if you allow them, a shield against the biting winds of winter, an assistant to all the crops your fertile field should grow. Let not our country degenerate, as older lands have, to a barren waste of stone and sand—countries which destroyed their forests. Let us rather remember that, as has been well said of old, the trees preserve the grass, the grass feeds the cattle, the cattle preserve the land, the land grows the man.

KEEP A GROVE NEAR.

How pleasant within easy walk of your house to have a woodland of five, of ten, or still more pleasant of fifteen acres. Let it not be a mossy wilderness of grassy land and old and dying timber, but a well fenced territory, where infant, half grown, and full-grown trees uninjured and fresh, cover the ground, clear cut of frame, tender and glowing of foliage as the bowers where Melibœus walked or Thyrsis sung. Enter for fifty steps, the world is gone; a hundred and the solitude is utter. Without, it is the hottest of mid-day suns; but the great leaf-roof above fills every sylvan arch with cooling shade, and passing where you will along these natural colonnades you breathe great draughts of life-giving forest air redolent of pine and balsam. On all sides outer sound is shut from you, the distant city bells are all unheard, the nearer mill has but a watch's tick; even the harsher noises of farming life approach the ear with muffled and not unpleasing touch.

Here is repose, for here is distraction from outer cares. Notice that the forest has a population of its own; and if you have not been a destroying tyrant but hospitable to the little harmless savages of the wilderness, a thousand lives will be around you, the existence of which you knew not. In yonder hollow, now seen, now hidden, the partridge is feeding her half-grown brood; the squirrel upon the leaning sapling beside you, glancing down with a half-friendly, half-careless air, is carving with his sharp curved teeth one of last year's nuts; and in the insect life on ground and fallen tree are bustling communities, colonies, monarchies, or empires, for what we know, crossing, meeting, working, assisting as if everything hung on their efforts, you were nobody and space were outside the fence.

Here is the home of retirement, the seat of contemplation, the birthplace of thought. He who has near him such a solitude may rear heroes, for the murmurings of the mighty trees roll laden with the whispers of ambition to the youthful ear; he who has it may hope for statesmen among his sons, for the converse of such a wilderness has nurtured throughout successive ages in many a succeeding race, in many a youthful and patriotic heart, the plans which in after days bore richest fruit of national life and national greatness.

If any of you should wish some practical ideas as to the best description of trees for windbreaks, I have noticed that those who have planted evergreens are best satisfied. Three evergreens, as remarked above, make an excellent windbreak. The first is our own Canadian pine, the next the Norway spruce, the third the cedar. I have known these three grow and flourish on so many different varieties of soils that it may be said they are suited to most localities. There is yet a fourth which I have observed makes a

very beautiful windbreak, but which is not yet so generally used, I mean the Scottish larch, though not exactly an evergreen, it forms a link between the evergreen and deciduous trees. The Norway spruce must be purchased, as must the larch, but the cedar and pine are often obtainable in our own fields and forests. It will be found best to take them from black, swampy lands, a much better root being there obtainable than when taken from sand; and it must be always remembered not to allow the roots to dry. As to size, I have known them to succeed well when planted five feet high; but my own method would be to confine them to three feet in height if they could be procured.

I take my leave of you now. The principles I have stated this afternoon you may rely upon. It is not I who speak, it is the voice of every century past saying, preserve your trees.

VILLAGE IMPROVEMENT SOCIETIES.

Something has been done by individual effort of late years to beautify the country by planting trees along the highways and on private grounds. But the movement here is not nearly so widespread as it should be, or as it is in the United States, where a great deal more attention has been paid to the subject. The advancement of public opinion as regards tree-planting for adornment across the lines has been greatly hastened by the establishment of village improvement societies by which organised effort is brought to bear on the undertaking, and the influence of the leading men in each community enlisted in the good work. In addition to the active and practical operations of these associations by means of which many villages whose highways were once bare and uninviting have been made models of sylvan beauty, they have done much by discussion and the publication of their ideas to awaken a general and far-reaching interest in tree-planting and forestry.

If similar associations could be organized throughout Ontario it would lend a marked impulse to the movement in favor of tree-planting by placing it on a broader footing and stimulating the apathetic and careless by the example of the more progressive and public-spirited. No one who has travelled much in the United States can have failed to notice how much more has been done to improve the aspect of the towns and villages than is the case in Canada. If the healthy impetus of local pride could be turned in the direction of beautifying the streets and homes of each community, each vying with the rest as to attractiveness, equally beneficial results would soon be noted amongst us. The following article by Mr. B. G. Northrop, which is taken from the *American Agriculturist*, gives some idea of what has been accomplished by means of village improvement societies:

The homes of the American people to-day are in happy contrast with those of fifty years ago in their architecture and surroundings. Of the many agencies tending to this result, none has done more than the hundreds of village improvement societies now scattered widely over the country. Their influence has not been limited to the towns, counties or States where they have been organised, for the discussions they have prompted, and the plans and ideas thus advocated by the press of the country, have benefited and brightened thousands of homes. The recent advocacy of village improvements by leading journals has given a strong impulse to this movement, so that more of these societies have been organised during the last year than in any previous ten years. It is an index of its value that practical and unsentimental railroad corporations now facilitate this work because it tends to improve and build up towns on their lines.

Though much has been accomplished—far more than I ever expected to witness when enlisting in this service, over twenty years ago—yet, compared with the public needs and the rich opportunities now opening on every hand, this work seems just begun. The most progressive and public-spirited communities are the very ones that are specially appreciative of organised efforts for the general good. Our best towns, without an improvement society, often fall far short of what they might be and ought to be, for in them, here and there, are found neglected private grounds, dilapidated dwellings, barns

and sheds, or a street fronting the house ugly with piles of decaying brush, or chips, old cans, harrows, carts or sleds, a fence with missing pickets, or a disabled gate which gives an air of shiftlessness sadly marring the effect of an otherwise beautiful village.

When an improvement society once develops private taste and public spirit, such defacements disappear. Where every citizen is thus stimulated to make his own wayside free from rubbish, and then neat and attractive, the entire town becomes so inviting as to give new value and attractions to all its homes. It is high praise to any people that they fondly cherish their homes. A stranger can hardly drive through such a town without saying, "Here are people of refinement, who tastefully guard the surroundings of their daily life." These surroundings, trifling as they seem, may be constant factors in forming character. Clearing up, dusting and putting things in order are little matters in parlor or sitting-room, yet how soon would each become forbidding were these trifles neglected. Just so in a village; let minor matters be neglected or slighted, and the comfort, content, reputation, and prosperity of a whole community suffers. But, worst of all, home life suffers, and character deteriorates. Modern civilization relates to the homes and social life of the people, to their health, comfort, thrift, and their intellectual, social and moral advancement. In earlier ages, men were counted in the aggregate, and valued as they helped to swell the revenues or retinues of kings. The government was the unit, and each individual only added one to the roll of soldiers or serfs. Happily for us the family is the unit of the State, and government is for the people as well as by the people. This gives to the concrete all the characteristics that make the home beautiful and attractive. Thus, love of home is primary patriotism.

When recently surveying a town, in order to adapt my lecture to local needs, as we passed a large house and spacious barns, with all the surroundings neglected and forbidding, my escort said: "Here lives the richest and meanest man of our town. Twenty years ago he brought here a refined young lady as a bride. For a few years it was her ambition and delight to adorn her new home without and within. At length her strong, innate love of the beautiful was cruelly crushed, for this thoughtless, if not heartless, wretch 'would no longer permit such waste of her time on good-for-nothing posies.' Driven to despair, she has been for years in the asylum among the incurably insane."

This may not be a typical case, but it contains a warning of wide application. While the pursuits of farmers, under right conditions, are highly favorable to health and longevity, too often they, and still more their wives, seem specially liable to depression and insanity. The farmer's home should be social and sunny. However humble, it may be tasteful and attractive. The isolation of the farmer's dwelling should suggest the wisdom and necessity of providing home enjoyments and fostering home courtesies. As flowers seem worthless only to the senseless, so the morning and evening salutations in the family may seem little in themselves, but, when fitly observed, they are constant forces, and therefore mighty in their influence. As the sunbeam is composed of many minute rays, so every farmer's home should be illumined and brightened by Nature's richest hues without, and, still more, within, by all the sweet amenities of life. These amenities and affections may be and should be, the sunshine of every home. They refresh and purify the social circle. Like the clinging vine, they twine themselves around the heart, calling forth its strongest affections, and securing its happiest and most healthful activity. Such affections dignify homely drudgery, make tough toils pleasant, painful sacrifices easy, and perils and privations cheerfully endured. Under the inspiration of such affections, there is often a genuine heroism in the home, unsurpassed, if not unequalled, by any which the world lauds on the battlefield.

The isolation of the farmer's home does not warrant gloom of mind or dreary surroundings. His home should be one of intelligence. Farming need not be a plodding routine life. A first-class agricultural paper is a good investment, that he may know the best agricultural processes and products, improvements and stock. For his own sake and that of his family, current events at home and abroad should be familiarly discussed. Brain and muscle need to work together, for the highest health of each. The dull and stupid are short-lived. The farmer works most cheerfully when the mental horizon is

broadened, so that he looks far beyond the sphere of his daily work. How many homes, even on the Western frontier, have been the abodes of intelligence, courage, industry, contentment and good cheer, where early hardships have developed noble characters that made the desert rejoice and blossom as the rose.

When in Nebraska city, the guest of an ex-governor of Nebraska, I found a happy contrast to the miser's wretched home. To this State, then a Territory, just ceded by the Indians to the United States, and still a wilderness, he brought his bride, a cultivated lady from Detroit, who cheerfully made the best of their log hut. Soon flowers, shrubs and vines sprang up on every side, until at length a veritable Eden, largely planted and tilled by her hands, surrounded that humble home, and in a few years a stately mansion, beautiful within as well as without, rose in its place. How much did her love of the beautiful and her purpose to create this paradise on which her heart was set when she first saw this spot, and saw, too, its possibilities, lighten the burdens and lessen the privations of a pioneer life. Bright visions of a beautiful home were an inspiration and a benediction to that happy household years before they were fully realised.

It seems fitting that such a home fitly named "Arbor Lodge," should be the birth-place of Arbor Day. It was a happy idea to designate a given day when all should unite in the work of planting trees. This honor belongs to Ex-Governor J. Sterling Morton, of Nebraska. The first proclamation for the observance of such a day was made at his suggestion by Governor Furnas, of Nebraska, and it is said twelve millions of trees were planted on the day thus designated. It was soon established by law as a legal holiday, and provision was made for awarding premiums to those who set out the most trees in its observance. The prizes offered for tree-planting secured definite statistics from official county returns, annually made December 31st. At the American Forestry Association held in Boston, September, 1885, Ex-Governor Morton said: "Arbor day has worked well in Nebraska, and we have growing in that State to-day more than 700,000 acres of trees which have been planted by human hands." The rapidity of growth of the forests first planted, not only cottonwood but more valuable timber trees, and especially the favorite black walnut, was a grateful surprise. It demonstrated the value of these trees for fuel, fences and lumber (the special need of treeless prairies), so that a great impulse has recently been given to this work. The latest figures are so enormous as to seem incredible to those who have not witnessed the interest, not to say enthusiasm of Nebraskans, in this work. So broad and beneficent have been the results of the Arbor Day movement in Nebraska, that its originator is there gratefully recognised as a benefactor of the State, now the leading State of America for tree-planting. It glories in the old misnomer, "The Great American Desert," since it has become so habitable and hospitable by cultivation and tree-planting. Where twenty years ago the school geographies said trees would not grow, the settler who does not now plan for tree-planting is the exception. The Nebraskans are justly proud of this great achievement and are determined to maintain their pre-eminence.

The laborers of France and Germany socialise far more than American farmers. The festive spirit is a marked feature of their character. It is manifested in the family, for young and old, rich or poor, all take their outings together—in neighborhood meetings, in processions and various social gatherings. Whole families seem to enjoy everything together as they visit the beautiful gardens and woods which abound in or near their cities and towns. In Germany, this genial spirit is everywhere fostered by music, vocal or instrumental. As every one sings, a concert may be easily extemporised at every such picnic. As a result, there is an inexpressible something in the German character that carries mirthful and happy childhood into old age, giving an added charm to social life, and lightness and cheer to sober work.

Village improvement is often carried on by individual, as well as by organised efforts where a citizen or a family of liberal views and large means become benefactors of their native town, and thus by example and personal influence awaken town pride and public spirit. Norfolk, Conn., furnishes a striking illustration of this kind. Twenty years ago it was a declining town. Now it is a favorite summer resort, proud of its recent growth and prosperity, and grateful to the families that have caused this transformation. Such an

example should prompt others. How many men of wealth in our favored age, like the Battell and Eldridge families in Norfolk, are enriching their own lives in becoming benefactors of their native towns by gifts for libraries, schools, cemeteries, fountains, parks or other institutions or improvements. It is a privilege to witness their happiness in seeing the fruits of such beneficence. What a contrast such noble characters show to the grasping and avaricious niggard—unhappy and unloved in life and unmourned in death.

PLANTING FOR IMMEDIATE EFFECT.

It is often the case that trees are planted extensively and set closely together for ornamental purposes, and allowed to grow up to maturity without being thinned out. For the first few years the effect is pleasing and the trees flourish as a rule much better than if they had been planted at long distances apart. But before long they begin to crowd each other. They have not room to expand and put forth their branches and if left to themselves, grow much as they do in the forest, long straight sticks with the foliage all at the top instead of presenting a leafy expanse of verdure at a short distance from the ground. Hence the importance of applying the thinning out process at intervals so as to leave each tree with ample room to spread. The following article from the pen of Mr. A. S. Fuller, which appeared in a late issue of the *American Agriculturist*, will be found instructive upon this point. The experience detailed will help to correct the impression that all that is needful to improve the appearance of a farm is to plant trees once for all and then leave nature to do the rest. That, of course, is better than nothing, but it falls far short of what can be done by judicious thinning out as the trees mature :

When I purchased part of an old farm in New Jersey, which has since been my home, there was not a square yard of grass upon it, nor a fruit tree or shrub except those growing in hedge rows, fence corners and in and around an old stone quarry in a corner near the highway. The outlook for a cozy home was anything but inviting, but it was in the country far away from the everlasting bustle and din of the city, and this was something to one who sought a quiet retreat and pure air, where he might build and plant to suit himself.

The first thing thought of after building a house and barn was a bit of green grass, and being somewhat doubtful about seed growing on an old worn sand bank, the roadsides were laid under contribution, and soon we had skinned enough of them to give us a few square rods of sward or just an edging of acres of lawn which I hoped to secure at less cost a few years later. The fruit trees and vegetables came next in order, and all, by much coaxing, flourished moderately well, but upon the approach of winter and as the deciduous trees and shrubs dropped their foliage, our surroundings seemed cheerless, cold and desolate, and the want of something green was not only seen but felt, for the cold north-west winds swept over the place, driving even the winter birds, squirrels and rabbits away to the woods for shelter.

My first winter here was enough in the way of experience to show me that evergreen trees of almost any kind would add greatly, not only to our comfort but to the general good appearance, too, of my grounds, so in the spring a special effort was made to plant as many as seemed desirable. Pines of various species, spruces, arbor-vitæ, hemlocks, balsams were selected, not omitting the *Kalmias* or laurels, hollies and other native undershrubs with evergreen leaves. Many of these were obtained from the woods, costing nothing but the labor of digging, hauling home and planting; others were purchased at a nursery a few miles distant. One week, with a team and three or four men, was sufficient to make a wonderful change for the better in the general appearance of my surroundings, and it has steadily improved ever since, as the trees increased in size, and new kinds were added.

At first novelties and rare species were not sought for, but those most readily obtained accepted, because the most common and cheapest would afford shelter and warmth as well as the rare and costly, and look just as green and cheerful when the snow covered the ground in winter, besides some of those usually classed among the cheap and common,

like the white pine and hemlock, should never be omitted, even from the most select list of hardy compeers. The kinds obtained were planted freely in groups, rows and as single specimens, and as usual in such cases I sought "immediate effect," and in carrying out this idea several trees were planted where there would be room for only one to grow up to maturity. But, having confidence in my own courage to cut down a beautiful tree when it became necessary, rather close planting was the rule followed. For instance, in one group of Norway spruces planted between my house and barn, eleven trees were set, ten have since been removed, and the one remaining is about fifty feet high and the lower branches cover a considerably larger area than the entire eleven did when first planted.

During the first five years after planting, and as thinning out became necessary, we thought little of it, for a few strokes of the axe would cut a tree down, and to haul it away to the brush heap involved but little labor, but as the years passed and the trees enlarged, the cost of removal became greater and now it is the work of hours, and sometimes days, to get rid of a tree twenty-five years old. Our ten minutes spent in planting have grown to ten or twice ten hours in its removal, and we are learning from some experience that planting for "immediate effect" may become a rather costly investment. It seems to be the general practice, however, in both private and public grounds, but the thinning out at the proper time is as generally neglected, and as a result all of the trees are ruined.

We have only to visit our public parks to see what "immediate effect" and "future ruin" means, and perhaps the two most striking examples of neglect are to be found in the Central Park of New York and Prospect Park of Brooklyn. In the former, the woodman's axe has been heard for years, cutting away worthless timber in the vain hope of saving a few fair specimens out of the hundreds that are being destroyed. In Prospect Park, however, the axe has not, as yet, been laid at the root of any great number of trees, although sadly needed, and every year it is delayed only increases the difficulty and will make the impending ruin the more complete. The crowding of a hundred trees into a space where ten would have been ample when planted, and even to produce the immediate effect sought, is now painfully apparent in the rapidly advancing ruin and decay of all. To thin out and remove the most worthless specimens at this time will call for an expenditure ten times the original cost of the trees, and when it is done there will be left a few long-legged specimens of the hop-pole type instead of wide spreading, beautiful trees such as nature produces when afforded room for development.

This very prevalent system of crowding and massing of trees and shrubs has not only been extensively practiced to the great detriment of nearly all private and public parks, but often extends to small gardens, where numbers of specimens is the ruling idea instead of perfect and fully-developed ones. The disastrous effect of the overcrowding of ornamental shrubs and trees becomes even more obvious in small places than in large, open grounds, where distance and massive effects make the defects of individual specimens less apparent to the passer-by. It would seem that we have plenty of artists in ideas, but few of execution. There is no end of beautiful designs in landscape gardening, but whatever merit they possess is lost in transferring them from parchment to mother earth. To plan is one thing, execute quite another, and the artist who attempts to design an ever-changing and progressive landscape must be able to look ahead, not ten years, but ten times ten, else his æsthetic ideas will soon be enveloped in chaos and moldy ruins.

ARBOR DAY IN SCHOOLS.

An excellent American custom, which has been wisely introduced into the schools of Ontario by Hon. Mr. Ross, the Minister of Education, is that of setting apart a day in spring to be observed by the pupils of our public schools as "Arbor Day." Nothing is calculated to encourage in after life a love for the beautiful in Nature and a desire to protect the forests and shade-trees from destruction more than an observance in which the children are taught to take a practical interest in the planting and growth of trees. The boy who has with his own hands planted a sapling and watched its growth year by

year until it becomes a landmark and an adornment to the neighborhood, has gained an experience which will bring home to him the value and pleasure of tree-planting far more than any amount of study could do.

The principal drawback to the practical success of "Arbor Day," so far as it has been observed in Canada, is that the area for its operations has been mainly, if not altogether confined to the school grounds. The space is too limited to allow of much tree-planting, and when the portion which can be set apart for trees is taken up, Arbor Day bids fair to degenerate into a mere formality. This should not be the case. Why could not the useful and practical nature of the custom be extended by having some of our tree-streets and public places planted by the public school pupils? If Arbor Day is to be a means of giving the young an insight into the principles of forestry, and combining actual results with theoretical instruction, the School Boards should see to it that its benefits are not lost for want of the means and opportunity to make plantations on an extensive and permanent scale. Mere playing at tree-planting will accomplish little of the good sought for.

In the United States Arbor Day has obtained general recognition, with the happiest results. The following synopsis of an address recently delivered by Mr. B. G. Northrop, of Clinton, Connecticut, before the Massachusetts Horticultural Society, conveys some idea of what is being effected by this means in influencing public sentiment in favor of tree-planting :

Arbor Day was first proposed by ex-Governor J. S. Morton, of Nebraska, in 1872, from the economic standpoint ; the great problem then was to meet the urgent needs of vast treeless prairies.

Arbor Day in schools was first suggested by Mr. Northrop, and was educational in its origin. Mr. Northrop's pioneer work in this direction met with indifference, and even opposition, from educational authorities,—but now the idea has become generally accepted, and Governors and school superintendents, who at first were apathetic, on fuller information have worked heartily for the adoption of Arbor Day. The logic of events has answered objections. Wherever it has been fairly tried, it has stood the test of experience. Now such a day is observed in thirty-nine States and territories in accordance with legislative Act, or by special recommendation of the Governor or State School Superintendent, or the State Grange, and the State Horticultural and Agricultural Societies, and in some states by all these combined. It has already become the most interesting, widely observed and useful of school holidays.

Arbor Day has fostered love of country. It has become a patriotic observance in the Southern States, which have fixed its date on Washington's birthday. It was a scene of thrilling interest at De Funiak Springs, Fla., when an enthusiastic crowd, young and old, gathered to plant a State tree for every State in the Union around their beautiful lake. Besides memorial trees to Washington and other patriots and philanthropists ; a brief State panegyric was made at the dedication of each tree.

This custom of planting memorial trees in honour of Washington, Lincoln, Grant, Garfield and other patriots, and also of celebrated authors and philanthropists, has become general.

Who can estimate the educating influences already exerted upon the myriads of youths who have participated in these exercises? This custom has been heartily commended by the eminent authors of America. The Arbor Day circulars within the reach of every scholar contain choice selections in prose and poetry on the value and beauty of trees. What growth of mind and heart may come to our youth as they learn these rich gems of our literature, and still more as they are thus led to apply them by planting and caring for trees ! What multitudes of youth have thus united sentiments of patriotism and the study of literature and history, with the love of trees, vines, shrubs and flowers, and thus with the love of nature in all her endless forms of beauty !

In the school geographies pupils learn of the trees and plants in foreign lands, while they are ignorant of those growing right about them. One farmer in Norfolk, astonished on seeing those varieties, admitted that he could not distinguish one-half the kinds of trees found on his own farm. Professor Brewer, of Yale University, says: "I have recently

talked with students, sons of well-to-do families, who could not give the names of three kinds of trees in our streets. They have grown up as ignorant of the trees of our forests and the crops of our fields as a Hottentot grows up ignorant of the stars." At the American Forestry Association, at St. Paul, Minn., the president of the School Board of that city, while advocating the resolution in favor of Arbor Day, said: "I am confident, from conversation with them, that not one in ten of the teachers of this city can recognise by sight ten of the commonest trees growing in this region." Since that date what a change has Arbor Day wrought in the sentiments and practical attainments in this line of both teachers and scholars.

Habits of observation have been formed which have led youth in their walks, at work or play, to recognise and admire our noble trees, and to realise that they are the grandest products of nature, and form the finest drapery that adorns the earth in all lands. Those talks on trees, which Superintendent Peaslee says "were the most profitable lessons the pupils of Cincinnati ever had in a single day," occupied only the morning of Arbor Day, the afternoon being given to the practical work.

Since 1883 our schools have rendered new service to the State, as well as to their pupils, by leading them to study the habits of trees, and appreciate their value and beauty—thus tending to make practical horticulturists and arborists. How many of these children in maturer years will learn from happy experience that trees, like grateful children, bring rich filial returns, and compensate a thousand fold for all the care they cost? George William Curtis says: "Arbor Day will make the country visibly more beautiful year by year. Every school district will contribute to the good work. The school-house will gradually become an ornament of the village, and the children will be put in the way of living upon more friendly and intelligent terms with the bountiful nature which is so friendly to us."

In New York 77,082 trees were planted in three years, and in 1891 8,955 school districts observed the day.

Indiana and Pennsylvania have kept Arbor Day both in spring and autumn. Pennsylvania is still the banner State in this work, by reason of the enthusiastic efforts of the late Dr. Higbee, who made earnest appeals to all teachers, school officers and friends of education, "to give this good work all possible encouragement, putting the thought and work of tree-planting into the schools. The boys and girls should be encouraged to collect and plant seeds and nuts of various kinds, and watch their growth and care for them. This is a work not for a day or a year, but for the profit of the succeeding generations. Every teachers' institute should discuss this subject, and every normal school should give it earnest attention." Over 300,000 trees have been planted on the successive Arbor Days in that State. Who can estimate the influences thus exerted on minds as well as on grounds—influences that will go on broadening through all time? In Illinois 10,000 districts were reported as keeping the day.

Maine reports: "After six years' observance, Arbor Day is growing more in popular favor, through the efforts of the press, the granges and the schools." Iowa has observed this day with peculiar interest. An elaborate circular has been annually sent to each school. The special effort last April was to develop local patriotism—State, county and town pride.

Many school grounds are too small to admit of ornamentation; sometimes smallest where land is cheapest, and totally inadequate to the necessities of the schools. Arbor Day has started efforts for their enlargement. State school reports now widely call attention to this defect, and urge that every school contain at least half an acre of land, and much more if possible.

Arbor Day in schools has proved an effective method of calling attention to the importance of economic tree-planting. In New England, and all the Atlantic States, there are large areas of barrens, worthless for field crops, that may be profitably devoted to wood growing. Our Atlantic sand plains that were once covered with woods can be reforested. Over 10,000 acres on Cape Cod, which thirty years ago were barren sand plains, are now covered with planted forests. The 200 acres of forest at Wood's Holl, of

Mr. J. S. Fay, and the 300 acres of planted trees of Mr. H. G. Russell at East Greenwood, R.I., are genuine object lessons for New England. On almost every farm there are waste places where trees might be earning dollars for their owners, growing by the brook or river, or on hillsides, or overhanging cliffs too steep for cultivation.

Arbor Day has proved as memorable for the home as for the school, leading youth to share in dooryard adornments and in planting trees by the wayside. Much as has been done on limited school grounds, still greater improvements have been made on the homesteads and the roadsides.

UTILISING POOR FARMING LAND.

There are two facts which must strike every observer of modern economic tendencies as showing the absolute necessity from the farmer's standpoint of individual self-preservation of tree planting and forest preservation. The one is the growing cheapness and abundance of ordinary farm produce, the other the increasing scarcity and dearness of the more valuable kind of timber. Ordinary foresight, such as any man in business is obliged to exercise day by day to save himself from ruin by observing the tendencies of the age and taking note of changed conditions, should have long since called a halt in the process of forest destruction and induced farmers to plant trees extensively as the best possible investment for the future.

Unfortunately many men are slow to recognise that the world moves. They look at things through the spectacles of their grandfathers and travel through life along the old ruts in which they were born. Their grandfathers cut down every tree in sight and planted wheat, because trees were plentiful and wheat scarce. They continue chopping down trees and sowing wheat, although in the interval an agricultural revolution has taken place. Timber is now scarce and wheat plentiful, but it makes no difference to them. They go on just the same as if the conditions of fifty years ago were those of to-day, notwithstanding that with the opening up of the prairie regions of this continent and other continents by steam communication, cereals are continually becoming cheaper. They continue the unequal struggle against the virgin fertility of the Western prairies, and the coolie labor of the East, growing wheat or other cereals on poor worn-out land better adapted for forestry, and neglecting altogether the opportunity offered of growing timber to provide for the needs of the future. It is no wonder that a business conducted with so little foresight or reference to the law of supply and demand often proves a failure. Were farms managed with an ordinary measure of business foresight instead of in the happy-go-lucky fashion which sees no farther than the next harvest-time; and the owners men capable of grasping the economic situation, and realising the import of the changes in agricultural conditions taking place around them, they might have easily averted loss and added to the productiveness and value of their land by husbanding their timber resources.

The problem of what to do with the abandoned farms of which so much has been heard lately is in a fair way of settlement. These farms have been abandoned, and many more are on the way to abandonment simply because they could not profitably compete in growing ordinary farm produce with the newer and more fertile regions opened up in the west. If partly planted with trees they would again become profitable. The fertility of the richer and more fertile portions would be improved, and the plantations growing in value year by year would eventually become a permanent source of profit. This is exactly what is being done in some of the Eastern States where there are large areas of land once under tillage lying idle. In *Garden and Forest* there appears an instructive description of an estate in North Beverly, Mass., which deserves the careful attention of all interested in rural economy, because it emphasises the fundamental principle underlying all successful agriculture—the adaptation of the crop to the character of the soil.

"The estate which stretches along the western shore of Lake Wenham, a beautiful sheet of fresh water, consists of 275 acres, and was bought in 1875 by the late John C. Phillips, of Boston. The purchase comprised a number of farms or parts of farms and various small parcels of land ; only a part of it perhaps forty acres in all being adapted to tillage. A hundred acres of upland and swamp were covered with a natural growth of hardwood, pines and soft maples, the remainder of the estate being overlaid by dry glacial drift, clothed with scanty herbage and occasional clumps of stunted blackberry bushes. Early attempts at cultivating this land had exhausted whatever fertility it had ever possessed, and the free range of cattle over it for generations had prevented trees from springing up to cover its naked surface and replace the forests of pine which should never have been cleared from it.

The dwelling-house was placed by Mr. Olmsted, who was asked to prepare a scheme for laying out the estate, on rough stone terrace built to receive it on the steep bank of the lake, and the drives as they appear on the plan were constructed under his directions. The beauty of the situation and the charm of the native woods on the sides of the old moraine in the north-eastern part of the estate had been the prime motive which induced Mr. Phillips to choose this particular site for his country home, but this once determined on it became necessary to develop some scheme for the economical treatment of the large area of poor land which could not be tilled except with large annual expenditures of money, and which could never be made into satisfactory and productive farming-land. It was evident that if the agricultural efforts of the owner could be confined to the good land that better results could be obtained than could possibly follow any effort to convert a larger part of the estate into a farm, and under Mr. Olmsted's advice this view was adopted. A tract of low, wet, rich soil, about forty acres in extent, in the north-west corner of the estate, and just north of the barns as they are now located, was thoroughly drained and made one of the best and most productive fields in Massachusetts. It remained to determine the destination of such portions of the remainder of the estate as were not already covered with trees. It was soon apparent that there was but one course to follow, and that was to cover it as rapidly as possible with such varieties of trees as grow naturally on poor soil, and so avoid the expense of annual tillage or the annual harvesting of unprofitable crops of scanty grass.

Mr. Olmsted's idea was to convert the whole estate, with the exception of the arable land in the north-west, into a more or less open forest, in the midst of which the manor-house should stand like a forest-lodge in an oasis of kept grounds confined to its immediate neighborhood and encircled by the boundaries of the terrace ; and although this plan has not yet entirely been carried out, all the operations of late years have been made with the idea of gradually extending the plantations over the whole of the dry uplands. The first plantation was made in 1880, and the area now planted is about seventy-five acres. A number of varieties of trees were tried, principally European larch, the Scotch pine, the Austrian pine, the Norway spruce, the white pine, the Douglas fir and the canoe birch, but of late years white pines have been used almost exclusively, about sixty thousand having been planted since 1883. The larch has grown very rapidly, making trunks a foot in diameter in twelve years, and are as thrifty and as promising of long life on the shores of Lake Wenham as the larch on Mr. Henry G. Russell's estate, described last year by one of our correspondents ; they are not as tall, however, as the canoe birches, which have grown on this soil with remarkable vigor, indicating the value of this tree, one of the best timber trees of our northern forests to plant on light gravelly soil. The Douglas spruce has grown rapidly, too, and vigorously, and there is every indication that it will reach a large size on this soil. The Colorado variety of this noble tree, which is certainly one of the most promising of all exotic conifers introduced into the north Atlantic states, can be seen in greater numbers on the Phillips estate than anywhere else, different individuals displaying a remarkable diversity of habit and a great variety of shades of color. White pines increase in height from one to four feet every year ; and the appearance of the young plantations indicates that, for covering the sterile hills of New England in spite of insects which attack and often deface it, this is the safest and the most profitable tree to plant.

We feel that an estate like this, managed intelligently on a system conceived and developed with the view to the best permanent economic results is an object-lesson of real public importance; any well-planned and prudently conducted experiment which directs public attention to the possibility and advantage of using lands not otherwise valuable in a way to secure a fair profit to their owner helps to establish and enlarge the prosperity of the state.

THE VALUE OF WINDBREAKS.

Wherever winds have a destructive sweep there is a lack of those provisions that nature would supply if let alone. Run an old-fashioned fence across a lot, and in ten years it would be the centre of a row of young trees, forming a solid windbreak. On knolls hereabout, if barred from cattle, hemlock and pines start. Fifty years ago I dragged rails to enclose a bit of land, which, to my boyish eye, was a delightful spot, where some tiny evergreens were trying to get a start on ridges and slopes and knolls. I was not interfered with, and so the cows were shut out. The result is now a thing of beauty. But that is not all; the winds that used to leap off the hill-top down on our orchards and barns are now decidedly broken. The only conifer native to our hills is the hemlock, and its beauty is hardly equalled. But the *arbor-vitæ*—readily takes to our soil, and I have used that for my hedges. Under the lee of these the sharp winds never are felt, and the effect is largely to restore climatic conditions that existed before the forests were so extensively cut away. Quinces, for example, bear once more as they did fifty years ago.

On one side of the street here fruit abounds that cannot be grown across the way. I have no trouble with Diana, Isabella and Iowa grapes, while even Concord does not get a fully ripe flavor a few hundred rods away. This is, to be sure, owing partly to the contour of the land, but it is also due largely to the additional protection given. The advantages are not only general, but special and local; we cannot only affect climate on a large scale by forests and by our plantations of screens and windbreaks, but we can make our own lawn or orchard climate.

Where land is abundant a belt of evergreens may be set. I have in mind one large orchard in this town, about one-third of which is sheltered in this way, and is in perfect health; two-thirds are exposed to the sweep of the north-west winds, and the trees are of no use except for fuel. The line of demarcation is plain to every one who drives by, and the contrast is almost startling. The effect on annual crops may not be so apparent, but it is logically sure. I am confident that one of the first duties of a purchaser of land is to study its exposure and plant screens against the most trying winds. While we are waiting for the Government to solve the forestry problem, we can in a small way control our own local climates to advantage.—*E. P. Powell.*

SIR WALTER SCOTT ON TREE PLANTING.

Sir Walter Scott, as is well known, was an enthusiast on the subject of tree planting, and expended large amounts in beautifying the landscape of his Abbotsford estate by laying out extensive plantations in which he took a great deal of justifiable pride. He had a thorough practical knowledge of forestry, such as was equalled by few men of his time. Sir Walter contributed a valuable paper on the subject to the *Quarterly Review* in 1827, which though having in view the planting of large estates in the Highlands under very different social and climatic conditions to those which prevail in Canada, nevertheless contains many ideas and recommendations which are applicable here with some modifications.

The same misapprehension of the objects and aims of forestry and unreasoning opposition to increasing the wooded area so often encountered in this country prevailed at the time Sir Walter wrote. On this point he says :

"To speak the truth, agriculture, as Mr. Shandy says of the noble science of defence, has its weak points. Those who pursue one branch of the art are apt to become bigoted and prejudiced against everything which belongs to another, though no less essential, department. The arable cultivator, for example, has a sort of pleasure in rooting up the most valuable grass land, even where the slightest reflection might assure him that it would be more profitable to reserve it for pasture. The store farmer and shepherd, in the same manner, used formerly to consider every spot occupied by a tree as depriving the flock of a certain quantity of food, and not only nourished malice against the woodland, but practically labored for its destruction ; and to such lamentable prejudices on the part of farmers and even of proprietors is the final disappearance of the natural forests of the north chiefly to be attributed. The neglect of enclosure on the side of the landlord ; the permitted, if not the authorised invasions of the farmer ; the wilful introduction of sheep and cattle into the ground where old trees formerly stood, have been the slow but effectual, causes of the denuded state of extensive districts, which in their time were tracts of what the popular poetry of the country called by the affectionate epithet of 'the good green wood.' Still, however, the fact of such forests having existed, ought now, in more enlightened times, to give courage to the proprietor, and stimulate him in his efforts to restore the sylvan scenes which ignorance, prejudice, indolence and barbarism combined to destroy."

The selection of suitable localities for tree-planting is a point of great import—and one too often overlooked. The observations of Sir Walter Scott upon this head are universally applicable and emphasise the necessity of being guided by the natural conformation of the ground. His advice as to the situation of timbered land is of course equally valuable when the question is as to what portions of a new farm should be cleared and what allowed to remain in bush. If it were generally followed, both in clearing and replanting, leaving the wood lots to occupy the rising ground regardless of lines of mathematical precision, our farms would not only present a more picturesque appearance, but would be materially enhanced in value by the better protection afforded the crops :

"The improver ought to be governed by the natural features of the ground in choosing the shape of his plantations as well as selecting the species of ground to be planted. A surface of ground undulating into eminences and hollows, forms to a person who delights in such a task, perhaps the most agreeable subject of consideration on which the mind of the improver can be engaged. He must take care in this case to avoid the fatal yet frequent error of adopting the boundaries of his plantation from the surveyor's plan of the estate, not from the ground itself. He must recollect that the former is a flat surface, conveying, after the draughtsman has done his best, but a very imperfect idea of the actual face of the country, and can therefore guide him but imperfectly in selecting the ground proper for his purpose.

"Having, therefore, made himself personally acquainted with the localities of the estate, he will find no difficulty in adopting a general principle for lining out his worst land. To plant the eminences, and thereby enclose the hollows for cultivation, is what all parties will agree upon ; the mere farmer, because, in the general case the rule will assign to cultivation the best ground, and to woodland that which is most sterile ; and also because a wood place on an eminence affords, of course, a more complete protection to the neighboring fields than if it stood upon a level with them. The forester will give his ready consent, because wood nowhere luxuriates so freely as on the slope of a hill. The man of taste will be equally desirous that the boundaries of his plantation should follow the lines designed by nature, which are always easy and undulating, or bold, prominent and elevated, but never either stiff or formal. In this manner, the future woods will advance and recede from the eye, according to and along with the sweep of the hills and banks which support them, thus occupying precisely the place in the landscape where nature's own hand would have planted them. The projector will rejoice the more in this allocation, that in many instances it will enable him to conceal the boundaries of his

plantations, an object which, in point of taste, is almost always desirable. In short the only persons who will suffer by the adoption of this system will be the admirers of mathematical regularity, who deem it essential that the mattock and spade be under the peremptory dominion of the scale and compass; who demand that all enclosures shall be of the same shape and of the same extent; who delight in straight lines and sharp angles, and desire that their woods and fields be laid out with the same exact correspondence to each other as when they were first delineated upon paper."

The writer quotes a noteworthy instance which fell under his observation as affording a practical test of the profitableness of the mode of planting which he advocates.

"A gentleman of our acquaintance had, some years ago, the purpose of planting a considerable part of a farm of about one hundred and twenty acres, which lay near his residence. It rented at about twenty shillings per acre. The proprietor, rejecting a plan which was offered to him for laying off the ground into fields resembling parallelograms, divided like a chess-board by thin stripes of plantation, went to work in the way we have mentioned above, scooping out the lowest part of the land for enclosures, and planting the wood round it in masses, which were enlarged or contracted, as the natural lying of the ground seemed to dictate, and producing a series of agreeable effects to the eye, varying in every point of view, and affording new details of the landscape, as the plantations became blended together or receded from each other. About five or six years after this transformation had been effected, the landlord met his former tenant, a judicious, cool-headed countryman, upon the ground, and naturally said to him, 'I suppose, Mr. R., you will say I have ruined your farm by laying half of it into woodland?' 'I should have expected it, sir,' answered Mr. R., 'if you had told me beforehand what you were about to do; but I am now of a very different opinion; and as I am looking for land at present, if you incline to take for the remaining sixty acres the same rent which I formerly gave for a hundred and twenty, I will give you an offer to that amount. I consider the benefit of the enclosing, and the complete shelter afforded to the fields, as an advantage which fairly counterbalances the loss of one-half of the land.' The proprietor then showed Mr. R. the plan which had been suggested to him, of sub-dividing the whole farm by straight rectilinear stripes occupying altogether about five and twenty or thirty acres. The intelligent and unprejudiced agriculturist owned that, *a priori*, he would have preferred a system which left so much more land for the occupation of the plow, but as frankly owned that the trees could neither have made half the progress, or have afforded half the shelter, which had actually been the case under the present plan, and that he was now convinced that the proprietor had chosen the better part."

The need of enclosure as a means of protecting the plantation from animals is fully dwelt upon, but as the author's recommendations in this matter refer almost entirely to local conditions, they need not be reproduced here. His observations with regard to drainage are more applicable to Canada:

"A preparation no less necessary than that of enclosing and now generally attended to, although often far too superficially performed, is the drainage of such parts of the intended plantation as are disposed to be marshy. Water, which, when pure, is the necessary nutriment of all vegetables, becomes, when putrid or stagnant, their most decided enemy. There exist no trees, however fond of subaqueous soil, which will thrive if planted in an undrained bog. On the other hand, there is scarcely any ground so swampy that, provided it affords a level for draining, may not be made to bear trees, if the kinds are well chosen. We have seen the spruce, silver fir, and even the balm of Gilead pine, attain great magnitude in a soil so moist that the trees were originally planted in what are called *lazy beds*. It must be, of course, essential that the drains should be kept open, and scoured from time to time, but it will be found that, as the trees advance, their own demand for nourishment will exhaust a great deal of the superfluous moisture; for as the fall of a natural forest in a wild country usually creates a morass, so the growth of a wood, when the first obstacles are removed, has a tendency to diminish a bog which has been already formed."

The necessity of care in planting cannot be too strongly enforced. Farmers and others are often disappointed with the results of setting out trees owing to the death or stunted growth of their plantations, and discouraged from making further improvements of the kind, when the trouble arises entirely from their own carelessness or inexperience. On this important point Sir Walter says :

“ And here we may hazard an observation, that, of all accidents detrimental to a plantation, those which arise from the slovenly haste of the workman are most generally prejudicial. Sometimes grounds are planted by contract, which, for obvious reasons leads to hasty proceedings, but even where the proprietor's own people are employed, which must be usually the case in undertaking in a distant and wild country, the laborers get impatient, and if not checked and restrained, will be found to perform their task with far more haste than good speed. The experienced woodman will guard with peculiar care against this great danger ; for a tree well planted will be found to grow in the most unfavorable spot, while plants, the roots of which have been compressed, or, perhaps, left partially uncovered, will decay even in the best soil and the most sheltered situation.”

In regard to pruning, an operation which so far as forest trees are concerned is much more general in Britain than in Canada, the most pertinent of the writer's suggestions is that it should be done at an early stage of growth. He characterises it as a great blunder to postpone pruning until the use of an axe is necessary when the injury inflicted on the tree will be much greater than if the operation had been done with the knife.

Sir Walter Scott's admirable paper concludes with the following general observations on the subject which present in comparatively brief compass such a clear and comprehensive view of the benefits of forestry from a broad national and economic standpoint, and answer so aptly and conclusively the short-sighted and selfish objections often raised that it may fittingly find a place here.

“ Indeed, it has always seemed to us not the least important branch of this great national subject, that the increase and the proper management of our forests cannot but be attended with the most beneficial effect on the population of the country. Where there lies stretched a wild tract of land, affording scanty food for unsheltered flocks, the country will soon, under a judicious system, show the scene most delightful to the eye—an intermixture of pastoral and sylvan scenery, where Ceres without usurping the land, finds also spots fit for cultivation. For even the plow has its office in this species of improvement. In numerous places we are surprised to see the marks of the furrows upon plains, upon bleak hillsides and in wild moorland. We are not to suppose that in the infancy of agriculture, our ancestors were able to raise crops of corn where we see only heath and fern. But in former times, and while the hills retained their natural clothing of wood, such spots were sheltered by the adjacent trees, and were thus rendered capable of producing crops. There can be no doubt that the protection being restored, the power of production would again return, and that in the neighborhood of the little hamlets required for the occupation of the foresters, the means of his simple subsistence would be again produced. The effects of human industry would, as usual, overbalance every disadvantageous consideration, and man would raise food for himself and his domestic animals in the region where his daily labor gained his daily bread.

“ There would thus arise in the wild desert a hardy and moral population, living by the axe and mattock, pursuing their useful occupation in a mode equally favorable to health and to morality. The woods, requiring in succession planting, pruning, thinning, felling and barking, would furnish to such laborers a constant source of employment. They would be naturally attached to the soil on which they dwelt, and the proprietor who afforded them the means of life would be very undeserving if he had not his share of that attachment. In a word the melancholy maxim of the poet would be confuted, and the race of bold peasantry whom want and devastation had driven from these vast wilds would be restored to their native country. This circumstance alone deserves the most profound attention from every class of proprietors, whether the philosophical economist, who looks with anxiety for the mode of occupying and supporting an excess of popula-

tion, or the juvenile sportsman who seeks the mode of multiplying his game, and increasing the number of his *gardes de chasse*. The woods which he plants will serve the first purpose, and, kindly treated, his band of foresters will assist in protecting them.

"We may be thought to have labored too long to prove propositions which no one can reasonably dispute; yet, so incalculably important is the object, so comparatively indifferent is the attention of proprietors, that it becomes a duty to the country to omit no opportunity of recurring to the subject.

"The only decent pretext which we hear alleged for resisting a call which is sounded from every quarter, is the selfish excuse that the profits of plantation make a tardy and distant return. To a person who argues in this manner it is in vain to speak of the future welfare of the country, or of the immediate benefit to the poorer inhabitants, or of the honor justly attached to the memory of an extensive improver, since he must be insensible even to the benefit which his own family must derive from the improvement recommended; we can, notwithstanding, meet him on his own ground, and affirm that the advantage to the proprietor who has planted a hundred acres begins at the very commencement of the undertaking, and may be realised whenever it is the pleasure of the proprietor that such a realisation shall take place. If, for example, he chooses to sell a plantation at five years old, or at an earlier period, there is little doubt that it will be accounted worth the sum which the plantation cost him in addition to the value of the land, and also the interest upon the expense so laid out. After this period the value increases in a compound ratio; and at any period when the planter chooses to sell his property, he must and will derive an advantage from his plantation, corresponding to their state of advancement. It is true that the landed proprietor's own interest will teach him not to be eager in realising the profits of his plantations, because every year that he retains them adds rapidly to their value. But still the value exists as much as that of the plate in his strong-box and can be converted as easily into money, should he be disposed to sell the plantations which he has formed.

"All this is demonstrable even to the prejudices of avarice itself in its blindest mood; but the indifference to this great rural improvement arises, we have reason to believe, not so much out of the actual lucre of gain as the fatal *vis inertiae*—that indolence which induces the lords of the soil to be satisfied with what they can obtain from it by immediate rent rather than encounter the expense and trouble of attempting the modes of amelioration which require immediate expense—and what is, perhaps, more grudged by the first-born of Egypt—a little future attention. To such we can only say that improvement by plantation is at once the easiest, the cheapest, and the least precarious mode of increasing the immediate value as well as the future income of their estates, and that therefore it is we exhort them to take to heart the exhortation of the dying Scotch laird to his son: 'Be aye sticking in a tree, Jock; it will be growing whilst you are sleeping.'"

WHAT IS FORESTRY.

A valuable addition to the literature of forestry has been made during the year by the issue of a brochure by Prof. B. E. Fernow, chief of the Forestry Division of the United States Department of Agriculture, being Bulletin No. 5 of its publications, entitled "What is Forestry?" The circulation of this work ought to do a good deal to clear away popular misconceptions as to the scope and purpose of the efforts being put forth by nearly every civilised government to prevent the destruction of the forests and the consequent impoverishment and depopulation of the country. Prof. Fernow, to show the importance of the question in its bearing upon the timber supply of the future, gives some interesting statistics as to the value of the forest productions of the United States. The total annual product of wood material of all descriptions consumed in that country may be valued in round numbers at \$1,000,000,000 representing roughly speaking 25,000,000,000 cubic feet of wood, or the annual increase of the wood growth of 500,000,000 acres of forest in fair condition. Its value exceeds ten times that of the gold

and silver output, and three times the annual product of the mineral and coal mines put together. It is three times the value of the wheat crop, and exceeds the gross income of all the railroad and transportation companies. The capital employed in milling, aside from that invested in cutting timber is estimated at \$650,000,000 and the direct manufacture of forest and saw mill products affords employment to upwards of 300,000 people irrespective of those engaged in its transportation and re-manufacture.

It is only comparatively lately that in addition to the obvious and direct value of the forest as the source of production of material which is so indispensable to our needs its value in promoting fertility, regulating climatic conditions, and equalising the supply of water has been fully established. It is to be regretted that a fact so vital to the future prosperity of the country has not even yet secured that general recognition which is essential in order to secure prompt and effective public action upon a comprehensive scale. The transition from the conditions of early settlement when every tree was regarded as a cumberer of the soil and a nuisance to be got rid of with as little delay as possible, to those which prevails to-day, has been too abrupt to allow the present generation to realise fully the need of forest preservation. And considerations of immediate profit to be made by the destruction of the remaining woodlands too often blind the individual land owner to the duty which he owes to the country and to posterity, doing his share by forest preservation or replanting, to avert those calamities which have invariably followed close upon wholesale deforestation.

As Prof. Fernow forcibly points out, many people have an entirely wrong impression as to the object of forestry. It is not contemplated to interfere with useful and necessary production, or prevent entirely the cutting of timber in the regions under forest management. On the contrary, the forest is treated as the source of a perennial crop, to be judiciously harvested to the best advantage, taking care to utilise the land to its fullest capacity for the growing of timber. It is not the cutting of timber that the forester opposes, but its destruction in such quantities and in so reckless a manner as to destroy or retard the prospects of future production, and leave the earth bare of its natural covering in those places where a wooded growth is essential to the maintenance of desirable agricultural conditions. So far as the settled portion of Ontario is concerned, the mischief has already been done, and large areas which ought to have been permanently maintained as forest-land, yielding their yearly supply of wood by the culling out of the mature trees, have been entirely denuded by axe and fire. The urgent question, therefore, as regards these districts is that of restoring the equilibrium by reforestation. We cannot do better than quote from Prof. Fernow's work the following instructive passage on forest reproduction.

REPRODUCTION.

There are three ways of reproducing a forest, which lead to three methods of management. We may either remove the original growth and replant the area, or we may cut it and expect the reproduction by sprouts from the stumps, or else we may so manage our cutting that seed from some remaining trees sows itself and produces a new growth of seedlings. Often any two or all three methods of reproduction may be employed together.

The first method, namely, that of replanting the cleared ground, is simple but expensive, especially in our country, where wages are high.

The method is objectionable, also, because by the removal of the original cover the soil is exposed to sun and wind, and is liable to be covered by weed growth, which reduces the chances of successful reforestation. It is, however, largely used in the pine forests of Europe with tolerable success, and has the advantage that the cutting may be done without regard to the seed production.

Planting becomes necessary where all original growth is absent, as in the prairies and plains, and on the devastated hill and mountain lands, or where, by lack of proper attention in cutting the forest, undesirable species have gained possession of the ground.

The second method, that of reproduction by sprouts from the stump, familiarly known

as coppice management, can be used only, of course, with such kinds as will sprout. The conifers, therefore, are entirely excluded, for although a few of them (sequoia, and some pines) do sprout, the sprouts do not develop into trees of size. Altogether, sprouts, while growing rapidly, remain comparatively short. This management is, therefore, only fit for the production of firewood, charcoal, ties, poles, posts, and wood of small dimensions. Most of the so-called second growth of the forests of New England and elsewhere in the United States consists of coppice growth, and does not promise much for future supplies of dimension timber. In time the stocks lose their vitality, and the quality of the forest deteriorates.

The third method, that of natural reproduction by seed, together with artificial planting, produces the timber forest.

There are various ways of applying this method; either leaving seed trees scattered over the entire area, or clearing strips and leaving a neighboring growth of seed trees to supply the seed for the reproduction on the cleared strip.

In these methods one is dependent on the seed-bearing of the mother trees, and it must not be overlooked that most, or many of our most valuable trees do not bear seed every year, at least not plentifully.

The clearing of strips, with seeding from the neighboring growth, is perhaps the simplest, and on that account may recommend itself to the lumbermen. It is applicable with success, however, only to those kinds which have light enough seed to be scattered over the cleared strip by the winds, and which can sprout and develop satisfactorily without the partial shade of nurse trees, and grow fast enough not to be crowded out by weeds.

To make this method tolerably effective, the width of the cleared strip should not be more than the distance which the wind is sure to carry the seed, say from two to four tree-lengths, according to kind, and that the clearing occur in or precede a seed year.

By reducing the size of the clearings to small openings the chances of successful reproduction are increased; and in this manner we come to the next method, which consists in a thinning out through the entire area that is to be reproduced, and letting in enough light to stimulate seed bearing, proper decomposition of the litter to make a seed bed, and to favor the growth of seedlings. The method of reproduction from seed trees standing on the same ground requires perhaps the least change from our present method of utilising the forest, which consists in culling out trees here and there. The main changes necessary would be to remove first the undesirable trees and the undesirable species, and to utilise the desirable only gradually after seeding has taken place, and in doing so keep in view the requirements of the young growth for either shade or more light. To do this successfully requires considerable knowledge and judgment, and in fact the art of the forester is here called into fullest requisition. Differences of condition necessitate differences of treatment. It would lead us too far to discuss in this paper at length what is required. I may only briefly recite an example, namely, how the beech forests are reproduced in Europe.

The beech, like many other timbers, bears seed only periodically. Seed years occur in different localities at periods varying from three to even twenty years, records of their occurrence being kept. A few years before the seed year is expected to occur the forest is somewhat thinned out to admit air and light upon the soil, in order that the litter of the forest floor be more rapidly decomposed and humified, and so may form a suitable seed-bed for the sprouting of the seed, and also to stimulate the mother trees to a plentiful production of superior seed. In this thinning the inferior material and the undesirable kinds are first removed, and such kinds as reproduce themselves easily without aid from the forester. When the nuts fall, pigs may be driven into the woods to plow them under. Under favorable conditions a soft, green carpet of young beech seedlings will be found to cover the ground in the spring next after the seed year. Now comes the critical period. If the mother trees were left, the whole crop would be lost, and while waiting for the next seed crop, under the altered light conditions which invite grasses, weeds and other species, the difficulties in securing reproduction are increased. By thinning out gradually the proper amount of light is given to the young crop, and when in three or four years

the last of the mother or nurse trees are removed, a thicket of young beeches has replaced the old growth. In a similar manner, with necessary modifications in procedure according to species, climate and soil, the natural reproduction of other species is effected.

It is almost invariably the case that when a plantation has been, as indeed it should be, planted too thickly at first, the subsequent thinning is neglected, often from negligence, but frequently because the owner is really not aware of the proper manner in which to proceed. Presently a time comes when to thin it effectively the branches of the trees cut down will, in being drawn to the earth, tear to pieces those intended to be left standing, and in dragging them to the outside of the wood they injure the bark of the others. A chapter on this subject, which we quote from the report under consideration, will be found valuable.

SPECIAL CONSIDERATIONS IN THINNING.

The three questions in thinning which always confront the forest manager are : When to begin and how often to repeat the thinnings ; how severely to thin at one time, or how many trees to permit to grow ; which trees to take out.

These questions, of course, can only be answered according to the special conditions of each case. As a rule, it will be best to begin this series of thinnings when the signs of the struggle for light begin to show themselves unmistakably ; that is to say, when a decided difference in individual development can be seen and the dominant growth be discerned from the laggards.

On strong soils and with light-needing species this occurs sooner, and the time for interference is more easily determined ; but in these cases assistance is also less urgent than on poorer soils, where more individuals are struggling in an even fight, and usually the separation into dominant growth and suppressed or laggards does not take place easily and early, and here, therefore, it is more needful to give timely assistance.

In practice, a consideration for beginning these thinnings is also the possibility of using or marketing the material cut out. But this is a proper consideration only because we do not know yet when it is profitable to spend time or money for thinning merely for the benefit of the remaining growth.

As a rule, the thinnings are begun in light-foliaged, rapid-growing trees with the fifteenth to twenty-fifth year, while with shade-enduring species one may wait until the twenty-fifth to thirtieth year ; that is, the time when the greatest annual height growth is attained and diameter development is desirable.

The questions how much to cut out and how soon to repeat the operation are somewhat interdependent.

In small wood lots, where the owner uses perhaps the thinned out material himself, a continuous gradual thinning is best, while on large areas it may not be practicable to do otherwise than to subject a larger area to the operation at once, and repeat it in a few years. In such a case enough must be taken out to avoid crowding until a second thinning, and yet not to cut so severely as to interrupt the crown cover too long and lay bare the soil.

The oftener the thinnings are repeated the better for the remaining growth. The repetition may be made every two or three years in pines and rapid-growing soft woods, while in shade-enduring and slow growers every five years may be sufficient. Condition of the growth and judgment alone can determine this. The same is true as regards the amount to be thinned out.

I repeat that there are always three considerations to be kept in view, and their requirements balanced, namely, conservation or improvement of favorable soil conditions, which requires dense shading, while large yield in quantity requires room and loose position, and trunk development in quality requires moderate crowding.

A study of crown development is necessary to form a judgment as to what is required. Here we have the predominant few, with an exceptionally full crown, while

the majority of the trees have only a moderately developed head. We next discern quite a number which have still a normally developed crown, yet form only a subordinate part in the main crown canopy. These three classes form the dominant growth and the active crown cover. Underneath these we find trees with small undeveloped crowns, suppressed, dying, dead. These last classes are, to be sure, out of the struggle, and their removal means nothing to the superior or dominant growth; they may be taken or left as their wood can be made useful or not. The question can only be which of the other three classes to favor and how much to open the crown canopy.

As to the latter question, soil conditions are to be consulted first. On poorer soils less opening is preferable; the same rule is good on steep hills, southern exposures, and where windfalls may be invited by too severe thinning. The age of the growth also has a bearing. Later on, when the principal height growth has been attained and the trunks are clear of branches to a sufficient height, and the formation of clean boles is not any more to be considered, the thinnings may be made severer. As a rule the crown cover should not be interrupted more than the remaining growth is capable of closing up again within three to five years; this would take rarely more than one-fifth to one-third of the growth if the crown cover was normal at the time of thinning. As to which class to favor and which to remove opinions are at variance just now. The old conservative school permitted the removal of the first or second class only, when either a more valuable kind was threatened to be overgrown and killed out by a less valuable, or when the latter had an abnormally spreading crown, overpowering more neighbors than it could possibly supplant in amount and quality of growth, or when malformed or diseased, or else when a growth showed too large a number of individuals developed equally, in which case the natural differentiation into dominant and overgrown takes too long a time to be accomplished naturally.

The new, more radical school argues that when the time for severer thinning has arrived, the foremost trees should be utilised first, because they yield the most valuable material and the next two classes are thus given opportunity to develop still into superior material, which they will do under the increased light influence, and that with more profit than if the stoutest trees had been given further advantages.

In the opinion of the writer this question cannot be decided for all cases alike, but species, age, and soil conditions may require one or the other principle to prevail.

In mixed growths it should especially not be overlooked that the light-needing species (like ash, oak, pine, larch) must have much more light than the shade-enduring (like maple, beech, spruce, hemlock) in order to develop at all satisfactorily.

It may be of interest here to state that through the means of thinnings the product per acre in the same time may be increased from three to five times of what the result would be were the forest left to itself.

One of the first things that the farmer, or in fact most individuals, consider with relation to tree planting is "What will it pay?" The following chapter from Prof. Fernow's pamphlet will give some light on the question. It must be remembered, however, that tree-planting pays in another way. Some time ago when in the Highlands, the foresters of Athol pointed out to me that where they had planted trees, the worthless heather previously near by disappeared and valuable pasture took its place. In the Lowlands one of the leading men of the country said to me, "I plant trees not for the timber, I plant them because both my pasture-lands and my cornfields adjoining become more fertile and yield me a higher rent."

PROFITABLENESS OF FOREST MANAGEMENT.

The question whether forest management is profitable can no more be answered in general than the question whether agriculture or any other business is profitable. It depends upon many conditions which differ in each case.

Broadly speaking, when we consider that the forests occupy or ought to occupy ground that is not good for anything else, that after being started it grows without in-

volving work, except such as yields valuable material, it will be conceded that the small exertion necessary to prevent the soil from being laid waste or occupied by inferior brush must be well repaid.

There are examples enough to be found in the United States where even forest planting in a small way has proved profitable; forest management on a large scale does not as yet exist.

To show what the financial results of management on a large scale are abroad, it may be of interest to add a few illustrative statistics, and it will be especially noteworthy in these what wide differences in expenditures and results there are to be found over so small a territory. These differences are due to differences of market facilities and intensity of management and also to forest conditions.

Countries.	Forest area.	Total expenditure.	Revenue.		Expenditures per acre.						Net revenue per acre.
			Gross	Net	Total.	Per cent of gross income	Administration and protection.	Marketing crop.	Cultivation.	Roads.	
	Acres.	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Prussia.....	6,000,000	8,000,000	14,000,000	6,000,000	1.33	58	0.48	0.30	0.14	0.06	0.96
Bavaria.....	2,300,000	3,150,000	5,880,000	2,730,000	1.37	53	.64	.37	.11	.11	1.19
Württemberg.....	470,000	1,025,000	2,260,000	1,235,000	2.17	45	.87	.92	.22	.33	2.63
Saxony.....	416,000	1,040,000	2,750,000	1,710,500	2.50	37	.65	.81	.11	.21	4.11
Baden.....	235,000	404,000	1,090,000	686,000	1.54	40	.22	.83	.15	.12	2.90
City of Zurich.....	2,760	14,000	26,000	12,000	5.00	54	1.14	2.10	.16	1.14	4.40

In fourteen state forest administrations of Germany, covering 10,000,000 acres, the cut during 10 years was 55 solid cubic feet per acre per year, of which 27 per cent., or about 15 cubic feet, was lumberwood, equal to about 120 feet board measure.

Figured on such basis of 55 cubic feet of normal annual accretion and a rotation of 80 to 100 years, the total normal wood reserves on these state forest lands would be in round numbers 24,750,000,000 cubic feet, worth, at 5 cents per foot, the average stumpage value, \$1,250,000,000. The net income from these lands averages \$31,500,000, namely, \$29,000,000 for wood and \$2,500,000 for other uses, or \$3.15 per acre, or only $2\frac{1}{2}$ per cent. on the value of the wood reserves figured at \$125 per acre. From this it will be seen that a considerable amount of capital is tied up in the wood reserves and brings only a moderate income. On such a large area, to be sure, there are many parts that produce but little and which depress the general results, areas which are managed for cultural and economic reasons and for the protection of watersheds, but which do not produce such revenues as would tempt the majority of private men, and hence the more reason for state ownership of these.

That, however, it is more profitable than otherwise to the farmer to keep his woodland in fair producing condition, and to the timber land owner to avoid all wasteful use of his property which prevents natural re-forestation, must be as patent as that a herd of cattle producing calves is more profitable than one which is barren.

FORESTRY IN INDIA.

Wherever forestry has had a fair trial its beneficial results as contrasted with the conditions prevailing in similarly situated countries or districts where no precautions have been taken to preserve the woodlands, are so marked as to force themselves on the

attention of every intelligent observer. In no country in the world perhaps are the advantages of the system in sharp antithesis to the destructive effects of forest destruction more obvious than in India, which has only been saved from the fate that has overtaken so many eastern countries once renowned for their fertility, but now barren and desolate wastes, by the wise and far-sighted action of her rulers in arresting the work of waste and spoliation. Under the government of sluggish and improvident despots, careless of the future and solicitous only to extort from their subjects the means for indulging the luxury and magnificence which have become proverbial, Persia, Syria, Central Asia, and the northern portion of Africa, once the garden spots of the world where nature rewarded the labors of the cultivator with lavish profusion, have long since lost their productiveness and become largely desolate and infertile regions incapable of supporting a tithe of their former populations. The decline of the eastern nations is almost wholly due to the destruction of the forests which once clothed their now sterile hillsides and barren sandy plains. Without stable and settled government, and subject to the constant vicissitudes and ravages of warfare, or the scarcely less harassing exactions of rapacious rulers, the people losing all concern for the future sacrificed to present convenience or profit the source of their national prosperity.

Precisely the same causes were at work in India until a comparatively recent date. The inroads upon the forests, owing to the natural apathy and carelessness begotten by centuries of oppression and misgovernment resulted in very considerably diminishing the fertility of extensive regions and causing numerous periods of scarcity and famine. At last the government of British India seriously alarmed by the climatic changes for the worse, and the decreased productiveness which inevitably resulted, took decided steps for the preservation of the forests as the only means of averting the calamities which have so conspicuously overtaken adjoining eastern countries. All travellers and officials in India who have devoted any attention to the subject testify as to the immense practical utility of the work already accomplished, and the magnitude of the peril from which Britain's largest dependency has been rescued by the government's timely action.

Sir Richard Temple, who held more than one responsible position in India at a time when special efforts to cope with the famine and avert similar catastrophes in future were being put forth, thus speaks of the condition of affairs in the Madras Presidency in 1877, in his well-known work "Men and Events of my Time in India":

"The wasteful destruction of trees, woods, or vegetation generally, and the necessity of forest conservancy being enforced more efficiently than before formed common topics of conversation among the most thoughtful and earnest of the Madras officers. The hill ranges in the interior of the country had been utterly denuded of vegetation and inroads were being made into the forests which still remained in some of the mountains. To these causes was in part attributed the disastrous irregularity of the seasons whereby the drouth in some months was succeeded by rainstorms and inundations in others. Observant men declared that in many places a sensible deterioration of the climate had resulted from the partial clearance of the forests. Again woods would sometimes be cut down which had retained or husbanded the moisture forming the supply of reservoirs for irrigation. Then the rain-water unrestrained would rush in superabundance to the reservoirs, silting them up or bursting their embankments; the water having thus exhausted itself would cease to flow, and thereafter the supply would fail. All this was duly represented to the Madras government and doubtless many remedial steps were taken. Still by reason of the treeless state of many districts and the diminution of forests generally there is danger lest the climatic conditions of southern India, including the greater part of the Madras Presidency and of Mysore, should undergo modifications productive of economic effects often adverse and occasionally disastrous. In respect to the prevention of drouth and its train of evils there is no subject more earnestly demanding the attention of government than the preservation of the forests."

Concerning his inspection of the Deccan in 1878, while he filled the position of Governor of Bombay, Sir Richard Temple writes:

"The marching along the hills afforded ample opportunity of studying the forests. Additional measures for preserving them were being adopted under the recently enacted

Forest Act with the zealous supervision of Mr. A. Shuttleworth, the conservator. Beyond the range of the Western Ghâts the Deccan was denuded of its vegetation as completely as the most treeless part of the Madras Presidency. Within the range, however, many forests happily remained and were being diligently conserved. The cattle-grazing which ordinarily proved injurious to the forest, was being restricted to particular 'blocks' or areas so that the vegetation might spring up in the remaining areas. Here were perceived all the ordinary reasons for preserving forests, the husbanding of the vegetation as a part of the national wealth, the permanent supply of the timber and fuel markets, the improvement of climatic conditions as affecting the regularity or irregularity of the periodical rains, the extension of moisture in a land where aridity prevails for several months in the year. In addition to these, however, there was a special reason in that from the mountains spring many rivers or streams which had been or were to be utilised for the storage of water in large quantities for irrigation. If the vegetation be preserved, the waters near the sources are retained to supply the canals; but if it be destroyed the waters become exhausted or evaporated and the canal must be left unsupplied. The destruction in the past, of some forests and the wasteful use of others, must be regretfully accepted as a proof that formerly neither the government nor its officers adequately appreciated the value of scientific forestry. The natives have been wholly blind to the subject and find difficulty in opening their eyes to it now."

The author goes on to point out that in regulating the access of the people to the forests and preventing unnecessary destruction the government of India labors under difficulties which seem to be of very similar character to those encountered in Canada and the United States. The natives, not satisfied with securing sufficient wood for agricultural or domestic uses, are anxious to exploit the forests for exportation and sale, and if they had their way the exhaustion of the timber supply would be merely a question of time. Human nature is curiously alike in all countries, and with the civilised Canadian as well as the dusky Hindoo, the consideration of a small but immediate and personal gain generally outweighs that of a great general advantage in the indefinite future. The principle of scientific forestry has seldom been better defined in few words than by Sir Richard. "The object" he observes, "is to treat the vegetation on the same principle as that which is applied to money by a financier who takes care of the capital and lives on the interest." The state forester is continually cutting and selling timber whereby the people really draw interest from the storehouse of national wealth without lessening their capital, whereas if the public were left to itself they would ravage the forests, wasting and destroying recklessly as well as consuming for their needs and in fact treating the national resources just as a reckless spendthrift does his money, in squandering his capital and so destroying the means of his future livelihood.

Managed with the distinct purpose of securing as large a revenue as possible while maintaining the standard of productiveness for the future, the forests of India now yield a cash revenue of two million dollars a year, in addition to the benefits they confer upon agriculture by preserving the fertility of the soil and conditions favorable to cultivation. According to the annual report of the Forest Department of the Madras Presidency for the official year, 1890-91 the total area of reserved forests and lands in the southern circle amounted to 8,701 square miles, being an increase of 360 square miles during the twelve months. The forest-administration has been compelled to exercise great vigilance in the prosecution of offenders in order to prevent injury to the forest and no fewer than 3,990 cases, principally for grazing cattle without permission and the unauthorised felling of timber were tried during the year. In eighty per cent. of the cases the accused persons were convicted. Much damage resulted from forest fires; in one instance an area of 2,700 acres being devastated. Referring to the condition of affairs which existed before the inauguration of the system of forest management the report says: "It is not too much to assert that the more valuable timbers—that is the teak and rosewood—were being exterminated in all the accessible forest areas in the southern districts—first for want of protection, and later on by heavy fellings of all mature trees, without any proper system of care for reproduction and insufficient protection." Large as the present revenue from the Madras forest is at present it is anticipated that it will be very considerably increased as the system is perfected and developed.

Edwin Arnold, the distinguished writer, who has always taken a deep interest in everything that concerns the welfare of India, in his book "India Re-visited," published in 1886, thus contrasts the State of Kattiawar, which yet remains under native rule, with the British provinces, and pays a deserved tribute to the wisdom of the policy of later years which has preserved to India the source of its greatness and natural wealth. Speaking of Kattiawar he says: "The soil hereabouts is full of nitrous salts which dry in a white crust wherever water has been deposited. Yet it is evidently very fertile and full of wells built with the sloping platform, where white bullocks draw the big skins of water up and then go backwards to plunge them in again to the monotonous song of the byll-wallah. But Kattiawar wants trees. Trees will save India and are saving her from the fate of Central Asia, desiccated by the nakedness due to waste of wood. The forest conservancy promoted by the British Rāj is one of its greatest benefits to the peninsula. India would have been a 'howling wilderness' if the sway of the Mogul or the Mahratta had lasted. It is her trees which hold the precious water in the earth and give shade, moisture, life. The peepul, the asoka, and the aswattha have never been half enough worshipped. Every forest officer is the priest of a true religion."

TREE PLANTING.

In former articles much has been said on this subject; but as it is well to keep the idea present in the reader's mind, a short synopsis of the best methods will be introduced here. In the first place, the soil should be put in as good condition as possible. It should be borne in mind, too, that while most varieties of trees will grow on nearly all the different kinds of soil, they will grow much better on a rich and fairly drained soil than on a poor or wet one.

Next, we must remember that the method of planting trees varies with their proposed location and purpose. If we are planting them at a distance, say of thirty feet, from one another, we shall have in time large independent trees, possessing many branches, some branching nearly to the ground. A line of such, at proper distances, makes an excellent windbreak, especially if evergreens are chosen for the purpose. But if we are planting for timber production, we should place our trees as closely as possible, so that for some years they will be striving to reach upwards above their fellows. This will tend to give long straight sticks, and should be encouraged by cutting off the lower branches, always remembering, in the case of evergreens, to do this while the branches are yet very small. This practice also tends to give clear timber, for every branch left makes a knot.

It will from this be observed that if, when planting windbreaks, we could make them of much greater depth than a single line of trees, we could grow a class of timber which the isolated line can never give us. This would be second-growth wood, and, of course, much more suitable for many farm purposes than that taken from the forest, as being of a much more tough and durable nature. Here we can grow the hickory, the ash, the elm and the cherry—all very valuable. If we plant black walnut, it is no doubt a valuable wood, but we must not expect it to produce wood fit for manufacturing purposes in much less than sixty years, while most others will be fit in half the time. I have seen large plantations of walnut at the age of forty years, which were then eighty feet high, and nearly two feet through at the ground. But the wood was not sufficiently mature for manufacture, and would not be, in the owner's opinion, till another twenty years had passed.

Yet this should by no means discourage walnut planting. The farm is more valuable, and will command a higher price, from the day the plantations are set out. It is as if we put money into a bank, to be drawn out when the farm is sold, or when, in after years, the timber is cut. There is this, also, to be said in favor of the walnut, that for many years before the trees are cut down, the crop of nuts should be of considerable commercial value. To effect this, however, in my opinion, it would be well to manure the sod around the trees. For the first eight years, indeed, the ground may be cropped,

preferably with a crop which needs hoeing and manuring. I have known the trees succeed well among Indian corn and potatoes.

Whatever be the kind of trees we are planting, there is one method of preparation of the soil which will very greatly promote growth, which is as follows: If the soil be of a hard or clayey nature, the addition of sand will greatly benefit it; nor are the benefits less observable when we add clay to a sandy field. It is well to procure these from the surface, as possessing more growing properties, yet deeper soil will answer, though not as well. The mixture of clay and sand assists greatly in bringing nourishment to the roots, and will be found to produce a much more reliable soil than either class of earth by itself. This has been verified by actual experiment on the lands of some of our most successful planters in western Canada. In Europe the mixing of earths has long been used as a method of increasing fertility, and it would, I think, owing to our different climate, and our shorter and hotter summers, be still more valuable here.

It would be well also, if, following the example of those in other countries, we should adopt the custom of planting the hill-sides, or some of the upper portion of farms, leaving the lower ground to agriculture. There are two reasons for this, first, that the higher land is generally a small proportion and the least cultivable, and next, that having the woods on a rising ground tends to give a regular supply of moisture to the rest of the farm. This has long been the method pursued elsewhere, and I have frequently observed instances in Canada which conclusively proved its value. What is most necessary to plant growth is a constant supply—not an overplus—of moisture to the land. Woods planted as above suggested assist in giving this, first by attracting showers, next, by storing in the forest bed, and gradually giving to the fields, the water which falls in heavy rains. The worst cases of “drying out” which ever occurred to me were where I had crops on upper ground, with no woods above them.

In planting evergreens there is one point to be noted, a wrong course in connection with which is the cause of many failures. These should be invariably kept moist, particularly the roots, from digging till planting. A deciduous tree will keep the sap alive for some time; but in the case of evergreens, the sap changes into a hard resinous substance, which destroys the life of the plant. Even the time while lying by the cavity prepared for planting them in is sometimes enough to kill them. The best way is, while they are being brought in the wagon, to keep them covered with some damp cloths. If the journey be long these should be re-wetted.

The question is frequently asked whether manure should be placed with the tree when being planted. Certainly raw manure should not be; it seems to burn the roots. Nevertheless, the richer the soil the better; but it should be rendered so by old manure, well mixed with the soil, so that no manure can be seen. In case of a plantation, the field should be well manured, and if possible summer-fallowed; then plant when the land is damp, either that fall or next spring. If we are planting a poor or rough piece of land, putting trees here and there, a cart-load or even a wheel-barrow load of earth well dug in at each place we plant, will be found of the greatest service. It is well always to dig wider than the roots spread, and to open these out. In the case of nursery roots, when healthy and with abundance of fibres, it is less necessary, as these are certain, with fair care, to prosper well.

The following extract from an official publication of some years back, well describes the situation:

It is surprising to see that, even with the bare facts staring them in the face, our farmers who are practically to-day the owners of the remaining timbered lands of the Province in all the settled districts, are in a condition of profound lethargy or innocent unconsciousness of the danger they invite or the losses they incur.

Still there is time even yet on many farms in not a few of the counties, for waste to be prevented, danger averted, and money saved, if men will only shake off the apathy they have hitherto exhibited, and see the true state of affairs in the light of self-interest, not to say self-preservation.

How little idea of providing against the continued depletion of the forests many of

them have, was well illustrated by an incident. The witness was a gentleman enjoying beyond most the confidence of his brother agriculturists—an admirable specimen of an intelligent and substantial yeoman. To the question, whether anything had been done in his district in the direction of replanting forest trees, he replied in an almost surprised manner :

“ We do not think we have reached the miserable condition which requires us to face that difficulty yet. We have more bush than there is in many parts of the west.”

But it happened that, just before, this same gentleman had told the Commissioners that his crop of fall wheat had been saved from winter killing—by what?—by the accidental shelter afforded it, not by his own, but by his neighbor's bush. But for this—the merest chance—one of the best farmers in Ontario, would not in all probability have had enough fall wheat to pay for the harvesting. And yet he almost scornfully repudiated the idea of planting trees.

Nor is this all. Not only have the farmers of Ontario destroyed property of fabulous value in the clearing process ; not only have they denuded their lands of necessary protection ; not only have they dried up their streams, and left dry ditches in many places to mark where once existed a valuable water-power ; but they have been, and still are going on very fast with the destruction of their supply of fuel. Instances have come within the observation of the Commissioners, where men who took up bush land thirty years ago have so thriftlessly managed their timber, that to-day, they have used the last stick and are actually buying cordwood.

SUGGESTIONS FOR PLANTING.

In enumerating the trees which I consider desirable for planting, I have named only those which could generally be obtained without any great difficulty or expense, in almost any part of Ontario, and I shall now give some data, which will show what growth these trees will attain within a specified time, taken from memoranda kept by myself which have come into my possession, and for the accuracy of which I am prepared to vouch :

“ Elm trees taken from the woods as young trees of about six inches round the stem, and between eight and nine feet high, have attained in forty-five years, a height and girth round the stem at three feet from the bottom, in several instances as follows : One 60 feet high, 8 feet in circumference at 3 feet from the ground ; one 65 feet high, 8 feet 2 inches in circumference at 3 feet from the ground ; one 60 feet high, 7 feet 9 inches in circumference at 3 feet from the ground. Another elm planted about fifty years ago, a small tree from the nursery gardens, has now grown to a height of 70 feet, with a girth at 3 feet from the ground of 8 feet and 6 inches.

“ A red oak, planted as a sapling about forty-eight years ago, is now nearly 50 feet high, and measures 5 feet 8 inches round the stem at 4 feet from the ground.

“ A maple of the same age is 6 feet 5 inches round the stem, and is nearly 60 feet high, and two others planted within the same period, are 6 feet in girth at 4 feet from the ground, and between 50 and 55 feet high.

“ All three of these were, when planted in their present position, young trees about 6 or 7 feet high—just the size at which they can be most safely transplanted when taken from the woods.

“ Of beech I have no record that I can entirely depend upon, but I believe one that I measured, which gave nearly 4 feet as the girth at about the same height from the ground, and was about 38 feet high, has been planted over forty years.

“ A butternut between forty-seven and forty-eight years old, measured six feet round the stem (four feet from the ground), and has attained a height of 75 feet.

“ Of two ash trees planted fifty years ago, one is 60 feet high, with a girth of 5 feet 6 inches ; the other about 55 feet high, girth a little over 6 feet (3 feet from the ground.)

“ It will be seen from this memorandum that the elm has made the most rapid growth of all these trees, and the maples come next ; although the ash is close upon them.

"Of evergreens (native) I can only give with certainty the white pine. Two of these—both planted fifty years ago—have reached, one a height of nearly 70 feet; the other a little over 60 feet. One measures 6 feet 6 inches; the other a little over 5 feet; at four feet from the ground.

"It will be seen, therefore, that, within an average of fifty years, trees transplanted at just such a size as they can be safely and conveniently taken up when growing in the woods (say from 5 to 6, 8 or 10 feet high), have attained dimensions which render them very valuable as firewood, as well as being perfectly sufficient for many useful purposes about a farm for which timber of a moderate size is suitable and requisite.

"I do not think that, with such facts as these, it can be said that there is anything visionary or impracticable in the means I have suggested for meeting the coming scarcity of timber in Ontario, and supplying the wants which will soon make themselves felt, even by the present generation of farmers, and will certainly press heavily upon their children, if not provided for in some way or other."

CONSTRUCTION OF SHELTER BELTS.

For screens and shelter belts where evergreens are used, Mr. Leslie gives the following advice:

"Trees for this purpose would not require to be of great height. If farmers consulted their own interest, I think they would commence by planting out small stock, say from 12 to 18 inches high. These trees grow very rapidly, say, on an average, three feet every year for the first five years, gradually lessening thereafter, and in a short time the farmer obtains a good shelter.

"As we get these trees (Norway spruce) from the old country, they are two years in the seed-bed and two years transplanted. That brings them from 12 to 15 inches in height and nicely rooted. When received in good condition, they are transplanted before being sold, and get a couple of years in this country, and are then removed. The tree is thus, in the latter case, six years old from the seed when planted for the purpose of shelter.

"All that we have ever sold have been raised in the old country (Scotland.) We find it much cheaper to import them than to raise them from the seed. Our climate is a little against raising evergreens from the seed; the sun is apt to scorch and kill them when in their early growth. In the moist climate of the old country they can be grown with much less care, and are raised and sold by millions.

"In planting a shelter bed, say an acre deep, the trees would not require to be placed closer than six feet apart; at that distance they would interlock in a few years. At six feet apart, about 1,200 trees per acre would be required, and they could be planted very cheaply by running furrows with the plow lengthwise and then across, placing the trees at the intersections of furrows. This would give the trees sufficient depth; in fact, I would rather earth up a little than plant too deep.

"I consider a good shelter belt can be made with evergreens two deep, placed say ten feet apart, with distance between the rows of five feet, and the trees placed so as to break the spaces of the rows. A shelter belt made in this way on the north side of a square ten acre field would require 130 trees, and for both north and west sides double that number."

Mr. Leslie adds:

"I prefer the Norway spruce wholly to the deciduous trees and evergreen mixed, as, in the latter case, the one kind checks the growth of the other."

Mr. Beadle also notices the fact that, while the lower branches of the other trees if they were allowed to interlock, would die in a few years, the Norway spruce becomes closely interwoven without the least injury, and forms a hedge so perfect the wind will hardly play through it at all.

PLANTING OUT EVERGREENS.

With regard to the planting and removal of nursery evergreens, Mr. Beadle says : "As a rule it is more difficult to transplant evergreens than deciduous trees, just because the foliage is always present in evergreens, whereas you can plant the others when it is not. But by taking evergreens just in the beginning of the spring, before they start into growth, if the season is not exceptionally dry, they are easily transplanted. The secret of transplanting them successfully is to transplant them when they are quite young, then let them stand for two years, take them up and set them further apart ; give them two years more and then transplant them again. If evergreens were transplanted four times before they came into the hands of the purchaser they would hardly meet with a death. But most men would sooner pay a few cents apiece for trees which have been transplanted once than pay a higher price for trees which have been frequently transplanted. Our people have not yet been educated into a knowledge of the difference as they have been in Europe."

Mr. Leslie makes a very similar suggestion. He says :

"My advice would be, unless the ground is in extraordinary good condition, to take the young trees as they are received from the nursery and make nursery rows of them, give them a little care until they arrive at the height of 18 inches or two feet, and then put them into permanent positions. They would require from two to three years to grow to this height, and would then be a good size to transplant. After that their ordinary growth is two or three feet per year in good soil and fully two feet in any soil, so that in six or seven years the farmer would have a good shelter."

FOREST FIRES THE GREAT DANGER.

Enormous as has been the wanton destruction of timber by the axe in localities entirely unfit for cultivation, which ought to have been carefully preserved as forest land, by far the greater amount of damage has been done by fire which in a single day can desolate a larger region than could be denuded by years of reckless slashing. The prevention of forest fires therefore is one of the most important features of any adequate system of forestry. It is of no avail to set apart parks and reservations or to enact pains and penalties against timber stealing, so long as the woods are left exposed to wholesale destruction from the carelessness of campers and hunters, or the want of proper precautions in clearing land.

A writer in the *New York Tribune* speaking of this weak point in the forest reservation policy of the United States as it affects the western forests, says : "The people living in the arid region know that for every tree cut a hundred are destroyed by fire. They realise how silly it is to punish a man for stealing a few logs while fires are permitted to destroy thousands of them. They laugh at the law, and a jury cannot be found which will send a timber thief to prison. This is only natural. It cannot be expected that the public will respect regulations with regard to cutting timber upon government lands when they see year by year large districts swept bare by flames as is still the case in some parts of Canada.

The attention of the people of the United States, especially on the Pacific slope, where so much depends on the forests of the Sierras for maintaining a supply of water for irrigation purposes is being forcibly directed to this evil. The damage done by fire can hardly be estimated. Mr. Thomas Magee, writing in the *Overland Monthly*, states that the fires caused by careless sheep raisers pasturing their flocks in the upper Sierra have for the past twenty-five years destroyed timber worth at least double the value of their entire wool crops. Last summer and fall the sheep men were driven out of the Yosemite reservation by the government patrol. The result was that no fires occurred in the woods, a thing unprecedented during a quarter of a century. The lighting of a fire in a wooded region even by careful and experienced persons frequently causes a conflagration, because

dead pine needles and underbrush during the dry season are as combustible as tinder and the slightest spark may spread devastation for miles around.

Mr. Arthur DeWint Foote, President of the American Society of Irrigation Engineers, who is naturally interested in forest preservation owing to its bearing upon the question of water supply, strongly urges that the states and territories interested in the reclamation of the desert region should have full control of public lands within their borders now owned by the federal government. The most forcible argument he advances is the continual danger to the forest from extensive fires, and the necessity of adequate protection by a system of fire patrols under the direction of those whose local interests are involved in their preservation. Some of the points in the following extract from his letter, which appears in the *New York Tribune* of the 20th of May, are of general interest, as showing the practical utility of the fire patrol system and correcting wrong impressions as to its expense.

The recent Irrigation Congress in Salt Lake City included some of the ablest men of the arid region. After three days of full and open discussion, they passed a resolution asking congress to cede in trust all the lands of the arid region—except mineral lands—to the states and territories therein. Perhaps the strongest argument put forward was that the states might, from the revenue derived from these lands, provide for the proper protection of the forests. They said to the government, grant us these forests which you are giving up to destruction and these grazing lands of which you can make no use, and we will save the one and develop the other.

A Board of Waters, Lands and Forests in each State will have the entire control of these great interests. The task is one of grave difficulty. It will call for men of engineering skill, men skilled in the law, men of executive force, and above all men of patience successfully to solve the problems which it will include. With the revenue from the lands such men can be secured. One of their first duties will be the establishment of a system of forest patrols, one to each thirty miles square, who will roam the forests the summer through. When in the still morning air a thin pillar of smoke rises from some deserted camp fire, the patrol at his post on a high bare point will hurriedly saddle his horse and before the day wind has fanned that smoke into a flame water from his leather bucket will have quenched the fire.

The destruction of the forests comes, not from the great number of fires, but from the few that are never put out. People are more careful about their fires in this region than is generally supposed, but there are no rains until the autumn to put out those that get started. In the Yellow Stone Park, although thousands of camp fires are made every year, the patrol have little difficulty in keeping down those carelessly left to run. It is the fires coming in from the outside that make the trouble and are fast destroying the wooded beauty of that wonderland.

This "Army of Patrols" which would be necessary to protect these forests is not a very formidable one. The state of Idaho has within its borders about 10,000,000 acres of forests and would require about 175 patrols. To maintain this force should cost the state about \$60,000 per annum. The state has also about 20,000,000 acres of grazing lands. One-quarter of these rented at two cents per acre would pay the expense of the forest patrol and \$40,000 more. The services of these patrols would also be in demand for watching and regulating the cutting of the forest products. There is no reasonable objection to cutting much of the timber of these forests. If properly done it would be a marked benefit.

It is proposed that these forest and grazing lands be ceded to the states in trust only; the state to retain complete control of the forests and to rent the grazing lands on long terms, in tracts not exceeding 5,000 acres to any one person. With the security for his improvements which this long lease would give, the settler would fence his allotment and secure water, either by developing springs or by artesian wells, irrigate a garden and perhaps an orchard. Soon these vast rolling plains which now appear so endless and so desolate would be dotted here and there with patches of green, and each would be a home surrounded by grass and gardens and trees. The endless war between cowboy and sheep-

herder would cease, because each would keep his bands within his own enclosure. The enormous wasteful herds with their annually starving thousands would be dispersed, and a sturdy though sparse population would find plenty where now is but a dreary waste under the domination of great cattle companies.

One of the principal sources of danger in our own backwoods is the building of fires by farmers for the purpose of clearing or burning rubbish. Many of these fires are unnecessary. So far as the destruction of leaves, rubbish, brushwood, etc., on a farm already cleared is concerned; it would in most cases be far better if these substances instead of being burned were piled up and permitted to decay when they would return to the soil many valuable elements of plant-food which are now dissipated in smoke. Fires for clearing the land ought never be permitted in the dry season or during high winds. Legal restrictions may do something to check the reckless lighting of fires which yearly causes so much loss and destruction, but the education of public opinion will accomplish a good deal more, as laws of this nature are difficult to enforce. The good effects of the fire patrol system, so far as it has been adopted in the timber regions of the Province of Ontario have been noticed already in a marked diminution in the number and extent of forest fires, and the cost has been trifling as compared with the immense saving effected. But much yet remains to be done in this direction, especially in the way of overcoming public apathy and indifference and arousing the community to the magnitude of the interests at stake.

LANDSCAPE GARDENING.

The art of landscape gardening is closely allied to forestry. While the former has for its object the retention and enhancement of the beauties of the natural scenery by artificial arrangement, the latter aims at the preservation for purposes of practical utility of the trees which form Nature's chief adornment and constitute the principal charm of landscape. Thus the two branches of sylviculture have in the main a common purpose. A knowledge of the principles of landscape gardening and a widespread diffusion among the people of an artistic sense of beauty leading to an appreciation of the picturesque and majestic in nature and a desire to adorn and beautify the home, would make the task of the forester a much easier one. Considerations of utility and profit would be seen to unite with those of sentiment and poetic appreciation in demanding the preservation of the woodlands and calling a halt to the ruthless vandalism which is as heedless of future material welfare as it is of æsthetic taste.

Though landscape gardening is generally regarded as a term applicable only to the beautification and adornment of the homes of the rich, or to the laying out of public parks, gardens and cemeteries, there is no reason why its principles should not be adopted on a smaller and less expensive scale in the improvement of many a country home. Every farmer in choosing a site for his house or barn, in deciding where to plant trees or leave a strip of woodland, ought to consider that the appearance which his farm will present; the beauty or disfigurement resulting from his operations, will either be a joy and an inspiration to himself and family during the coming years or an eyesore and a constant source of dissatisfaction. Dull, monotonous and ugly surroundings, the lack of harmony and beauty in their daily lives, have more than anything else been the cause of the exodus from the rural districts to the cities. A farm house on an ill-chosen site without a tree standing near it to relieve the monotony of the prospect, with no grateful shade or cool expanse of vegetation, is a sight too often met with in our rural districts. A very slight amount of attention given to making the homestead attractive in addition to brightening the lives of its inmates would have added considerably to the money value of the property.

The following article on landscape gardening by C. H. Miller from the *Philadelphia Times*, though treating mainly of the more extensive and costly undertakings pursued in this branch of art, yet contains some valuable suggestions which may advantageously be put in practice on a humbler scale by those seeking to accomplish the harmony and the bridal of beauty and of use.

In the choice of situations for a country residence, attention should be particularly paid to its convenience in site and position with regard to the adjoining country, so as at once to be in itself picturesque and at the same time to afford picturesque views to the inmates. When the surface of the location decided upon is but slightly raised, the highest point will be found generally the best, most appropriate and agreeable, but, on the other hand, if the hills are high and inconvenient for easy access, a gentle slope at the bottom will naturally be the best situation for the residence.

The bank of a swiftly running brook or the margin of a lake, particularly where the banks are well wooded and diversified with overhanging cliffs and rocks, will afford a good situation. On such a location as thus described, the building itself should be somewhat irregular in shape and outline, and careful attention should be paid to the position of the principal rooms, and the carriage entrance should be so located as to admit of easy approach.

The style of the building should be in harmony with the surroundings, designed and regulated in accordance with the nature of the situation. In an exposed situation, the mansion should be planned to have the appearance of strength and solidity. On lower levels, where the trees are healthy and luxuriant, their outlines narrow, round and flowing, the building may be high, light and elegant. Large and more splendid edifices should be located so as to have ample space around them, large acreage, broad horizons, generous lawns and long sunny glades. Parks and woodlands are the *sine qua non* for such lordly places.

Artists and men of taste all acknowledge that forms of beauty are composed of curved lines, and I may add to this that in gardening the more gentle and gradual the curves the more beautiful are they. The same principle applies to the surface of the earth as to other objects. The most beautiful shape in ground is that where one undulation melts gradually and insensibly into another, and landscape gardeners well know, or should know, that no grassy surface is so captivating to the eye as one where these gentle swells and undulations rise and melt away gradually into another form.

Many places are more appropriate for the growth of some kinds of trees than others; this fact should receive the particular attention of the landscape artist, for trees well placed as to form and color are the most elegant appendages to landscape scenery. The artist should be thoroughly acquainted with the material that he has to use. It is absolutely necessary that he should have a thorough knowledge of the habits and growth of trees of all kinds. There is an art in the planting of trees alike for shade, shelter or for ornamental purposes. The knowledge of where to plant is just as essential as to know how to plant, and no man can be a successful landscape artist who is ignorant of the science of planting, be it either for utility or ornament.

Where a surface is quite level by nature the artist should content himself with trusting to planting and the arrangements of walks, buildings, etc., to produce beauty and variety, and should always in such cases rather expend money in introducing groups of choice plants and other works of positive artistic merit than to terrace and unmake what character nature has stamped upon the ground. Positively ugly and forbidding surfaces of ground may be made highly interesting and beautiful only by changing their character by planting.

In planting with a view to natural beauty the effect of the design of the whole is the first and grand consideration. All planting, as respects the formation of a country residence, is generally influenced by the character and situation of the house as the main feature in the composition. This object in view, the expression of art and design suggest the employment of different species of trees and shrubs to those which are natural to the locality. The selection of trees for such purposes calls for the exercise of much taste and discrimination, and should hardly be undertaken by those who have but a slight knowledge of the subject.

A landscape gardener should be able to unite practice and theory, should be expert in drawing both in field and indoor work, and should know something of geometry, the management of squares, levels and lines, be well acquainted with projection and perspec-

tive, that he may anticipate the resultant effects of his work, and he should possess still further requirements to enable him to claim the title of artist.

The gardener who has succeeded in raising a new chrysanthemum, a rose or carnation, who has produced something where another man has failed, is, in his line, an artist. And he is more than an artist; he has done something more than nature unassisted can do. Suppose we have a young, growing tree that, by bad pruning or by accident, or otherwise, has been deprived of its main shoot—to use a professional term, its leader—and thus by giving additional strength to the top lateral branches has permitted them to become aspirants for leadership. The shape of the tree becomes abnormal; it is broom-headed and unshapely. Now put this tree in the hands of a practical man who thoroughly understands his business and is able to comprehend what nature intended. He will select the stoutest and straightest lateral leader, will tie and secure it in an erect position, shorten in the disputing laterals, thus giving greater strength to the new leader. Under this treatment the young tree will soon assume the shape that nature intended. Now the first man who has the disposition and the ability to do this and similar things is an artist, and something more than an artist, for he is capable of changing and assisting nature and of studying her various moods. And the man who is capable of changing the rough, uncultivated and barren lands into productive fields and pastures, and again by judicious and tasteful planting of groups of trees, convert them into a beautiful landscape of woodland lawns and meadows of park and garden scenery, is an artist and a great artist. Those who look on the profession, not as an artistic study, but rather as a commercial pursuit, never can become great landscape artists.

It would not be out of place for me, as a landscape gardener, to speak of some of the improvements that are contemplated in the near future towards the adornment of our city.

A few well-chosen trees, properly planted and carefully tended, with a good, thick, closely mown carpet of grass, will be more appropriate than a struggling mass of unshapely objects. That trees increase atmospheric humidity, absorb malaria and produce a refreshing coolness is an established fact. They are the best and most health-giving agents that can be introduced in densely populated cities. They should not, however, be planted so thickly in the squares as to interfere with the free sweep of light and air or to prevent the free growth of grass between them. Patches of shade and sunlight are most productive of a free circulation of fresh dry air so essential to health and comfort.

Trees, either for use or ornament, or both, must have ample room for development, and a wide pavement is absolutely necessary for the purpose. They should be planted far enough from the house line to allow for the free circulation of air, or the prime object is defeated.

Trees that are best adapted to planting in the city thrive just as well when planted under a brick or stone pavement as when planted in narrow strips of grass, and the pavement is much more easily kept neat and clean, whereas the borders would have to be freshly sodded every season besides requiring constant attention every few days throughout the summer. To have well grown, healthy trees in the city the kinds best adapted to the purpose should be chosen, and only planted where there is ample room for their development. Good, wide pavements, well chosen trees and careful attention after planting are the conditions necessary to success in city planting.

THE SANITARY VALUE OF FORESTS.

Apart altogether from the value of forests in conserving the climate and furnishing provision for our commonest material needs, their utility from a sanitary point of view is one of the most powerful, though perhaps least regarded, arguments for their preservation. It is obvious that the climatic changes resulting from extensive deforestation, which are unfavorable to fertility by causing drouths, floods and exposure to parching and sweeping winds, cannot be otherwise than directly injurious to human health. The

absence of trees which transforms once fruitful and productive areas into barren deserts not merely robs the population of the formerly abundant means of subsistence but in addition renders it less adapted for the abode of civilised man. Forests influence the health by their effects upon the constituents of the atmosphere and the water supply, their absorption of noxious gases and emanations and the healing balsamic virtues of their exhalations.

A knowledge of some of the primary truths of animal and vegetable physiology is essential to a thorough appreciation of the relations which the two leading divisions of organic life sustain towards each other. That each has an important bearing on the other is evidenced in the fact that the carbonic acid exhaled by the animals is absorbed by plants, which build up their tissues with the carbon and restore the oxygen to the atmosphere. Respiration, which is an animal function exclusively, supplies the system with continual draughts of oxygen, the prime necessity of animal life, which combining with the effete and worn out tissue promotes its removal, thus making way for new tissue substance. This renewal of the system by molecular metamorphosis must continually go on so long as life remains. In this way, every living animal is exhaling into the atmosphere, carbonic acid which can only be decomposed and rendered harmless by an abundant vegetation eager to absorb and assimilate this otherwise poisonous element. The decomposition of vegetable matter and all dead organisms and the combustion of fuel, oils, etc., in the production of heat and light also add immensely to the volume of carbonic acid gas with which the air we breathe is charged until it becomes more or less purified by the demand of the vegetable world for this important constituent of plant growth. The action of vegetation in decomposing the carbonic acid is believed to be the only source of free oxygen and means of renovating the atmosphere surcharged with animal emanations. "Hence" in the words of Prof. Gray "the perfect adaptation of living beings to each other; each removing from the atmosphere what would be noxious to the other; each yielding to the atmosphere what is essential to the continued existence of the other. The need of a due proportion of vegetable to animal existence is strikingly shown in the aquarium where aquatic growths fulfil the same function in regulating the purity of the air in water that land vegetation does in the atmosphere. If the equilibrium is disturbed by too great a preponderance of animal life, the fish or other inhabitants sicken and die for want of oxygen. The necessity of vegetation in sufficient quantity and luxuriance to counterbalance the presence of a large population and keep the atmosphere pure by absorbing carbonic acid and giving forth oxygen is an established scientific truth. And of all kinds of vegetation trees will best fulfil this sanitary function, because the carbon assimilated by them is more permanently withdrawn and retained for centuries, being finally returned to the earth as *humus* instead of given out to the atmosphere as carbonic acid.

The importance of an adequate water supply for sanitary purposes is a matter universally conceded, and the influence of forests in regulating and equalising the flow of water and forming a natural reservoir has been so fully set forth elsewhere that it would be superfluous to do more than allude to this phase of the subject. In addition however to the effect of forests upon the water supply, as the term is generally used, they perform a most important service in cooling the atmosphere during the parching heats of summer and averting disease.

Heat increases the capacity of air for water according to Camille Fiammarion. At 14° Fahrenheit one cubic foot of air is saturated with one grain of water; at 30° with two grains; at 56° with five grains; at 80° with eleven grains; and at 88° the point of saturation is not reached until fourteen grains of water have been added to each cubic foot of air. It follows that the effect produced upon climate by a copious supply of water to an atmosphere at a high temperature must be very marked. Now trees in addition to their influence upon terrestrial radiation, are able to draw up moisture from a lower level than that attainable by smaller vegetable growths, and give it out through their leaves, an enormous volume of aqueous vapor is thus exhaled by every large tree in full leaf and healthy condition. The experiments of the German scientist Von Pettenkoffer showed the amount of evaporation to be no less than eight and one-half times more than the volume of the rain

fall upon the same area. The moisture thus supplied to the atmosphere is often drawn up from great depths, and is an important factor in mitigating the severity of extreme drouths and preserving healthful conditions.

Forests and smaller areas planted with trees are of undoubted value in preventing the dissemination of malaria. That form of disease is due to the combined influence of heat and moisture, and recent investigation has proved that many of the conditions of its growth and diffusion are capable of being controlled. Experience has shown that forests and tree-belts form an effective barrier to its transmission. The eucalyptus among trees and the sun-flower among annuals are considered the most useful of their respective classes as destroyers of malaria. The ancient Romans recognised the value of forest masses as a barrier against the diffusion of fever germs, and to secure them against destruction invoked the protection of their divinities. Prof. Flint has expressed himself as follows on the subject: "Malaria has an attraction for trees and other organic materials. It is found to be perfectly practicable to prevent the access of malaria to dwellings by planting large trees or thick shrubbery in the immediate vicinity between the originating points and the house to be protected." Prof. Metcalfe in his "*Monograph on Malaria*" says: "Malaria has an affinity for dense foliage which has the power of accumulating it when lying in the course of winds blowing from malarious localities."

The turpentine exhaled from pine and hemlock forests possesses in a larger degree than any other substance as far as known the power of converting the oxygen of the atmosphere into ozone. This agent owing to its remarkable affinity for the products of decomposition purifies the air by the destruction of deleterious gases and the oxidation of decomposing organic matter. Hence the high estimation in which the pine-growing regions are justly held as sanitary resorts where the purity of the air strengthens and renovates the system debilitated by the foul atmosphere and unsanitary conditions of our crowded centres of population. Viewed from this aspect as a purifying agency for keeping the air we breathe fresh and bracing, and destroying by its power of absorption the germs of disease, the forests have a value far greater than can be estimated in money, and their preservation is a matter not merely affecting the volume of the national resources and the fertility of our fields but the physical well-being of the people and the fitness of our country for healthful habitation.

FORESTS OF EUROPE.

In any attempt to improve Canadian forestry it is necessary to look to other countries, and especially to Europe. It is not that the other continents do not possess timber; in both Asia and Africa the forests are immense, every river flowing through forest land exhibits a continual succession of rafts. But they are little known; great cargoes of wood do indeed regularly descend these waters; but the European or American would find it often difficult, and in some cases impossible, to penetrate to their sources.

In Europe, on the contrary, we have the results of many years of timber culture, records of the various methods of treatment pursued are regularly kept, and available for future use. So far as is possible, considering the difference of climate, we find there any number of examples of forest work, from the preparation of the ground to the cutting of the timber. Their methods are different; for instance, trees are often sawed off close to the ground. Their tools, too, are unlike ours. The axe of the English woodman differs in shape from our well known tool; the handle is often straight, and the steel much narrower and projecting an inch beyond that used here. The accompanying article by Mr. Putnam of Wisconsin, contains much valuable information, especially with reference to the number of men employed, and the manner in which they are promoted. The last paragraph, concerning the too rapid destruction of the forest, is very telling. It is furnished by *Garden and Forest*:

While in Europe in 1885 I noticed in Germany, particularly on the lower Elbe, the Spree and generally over the old worn out lands, that much was being done to preserve the old and replant new forest trees in regions from which 200 or 300 years since the

forests had been destroyed. At the schools of forestry intelligent men asked, "Why do not you Americans learn by our errors and do something to save your forests now?" The only reply I could make was that I hoped we might begin to save before we were driven to it by necessity as other nations have been.

The new forests over Prussia from Hamburg by way of Berlin through to Breslau and in the circle with the distance from Berlin to Dresden as a radius are doing well. It is common to see plantations largely of pine of from forty to six hundred acres ten, fifteen, thirty-five and fifty years old, all within a few miles of each other, the different heights of trees on the land lines sharply showing their different ages. Some of the older trees are sixty feet high and eighteen to twenty-five inches in diameter, all growing very even and thick. These plantations are kept clean, with the lower dead branches broken off for use by poor people as fuel, and all this on land that looked light and as if it had been run out like the "old fields" of the Carolinas and Virginia. Many of those new forests in Germany were being cut clear for the timber, lumber and wood, others were being preserved with the best trees cut out and sold under care of foresters. The land itself was being revived and was approaching a virgin condition again. These new forests now furnish the timber of the country.

In the forests of Saxony and Bohemia, up the Elbe and Spree, more particularly of Saxon Switzerland and up the river Elbe into Bohemia. I visited some twenty or thirty mills that were sawing timber grown upon the streams tributary to these waters. Some good trees were worked up here thirty and thirty-six inches at the butt end, and cut the whole length, say sixty to seventy feet long. In the larger mills the whole log is run through gang saws, and then the product is tied up as one log by itself and so sent to market slab and all. The saws used were thinner than ours. Very small logs, too, often no more than five inches in diameter, are cut. The price of this lumber was no more than it is in the Middle or New England States, but of course the Europeans use less lumber than we do. From an extensive examination of Germany, Austria, Belgium and north-eastern France, northern Switzerland and the Duchy of Baden, I should say that under the wonderful care and intelligence of the present system the forests were quite keeping up with the demand for the common lumber wants of the country, and some even being shipped to Portugal, Spain and the Mediterranean. I visited the saw-mills on the Necker and the Rhine, climbed the Feldberg and the Taunus, and saw foresters carefully cutting and sawing the windfall trees and planting a new one for every tree taken out. The Government is doing so much for the forests everywhere. In the little province of Baden, smaller than some of our New England or New York counties, over 100 men are employed and paid by the Government to care for the woodlands. In Saxony and Bohemia I went to the homes of the foresters, and found some of them experts in various branches of natural history. The heads of departments were graduates of some school of forestry, and they were advanced as they deserved and held their offices for life or good behavior. The Germans have waited until their timber was cut off before they began to replace it, but they are now prosecuting the work with rare patience and skill.

In the summer of 1887 I visited again the British Isles, and examined the lumber industry of the eastern coast, of Edinburgh particularly. I saw much of the lumber of Norway and eastern Russia as it was brought into England. There is little large or wide timber left in those countries. Much the same process of stripping forest areas has gone on there as in the countries before named. There is much less timber in Norway, Sweden and Russia available than is generally supposed and its quality is poorer—sound enough, but hard and full of knots, very much like the lumber of lower Europe. Evidently virgin forests of the north temperate zone are in North America. The impression created by the European forest examination made by me in 1885 and 1887 is this: Trees will grow if properly planted and cared for, but it is like the first attempts in raising the tame grasses from the old farms of the east in the virgin prairies of the west. The soil seems rich enough to grow timothy, but the cultivated grass will not flourish until the wild "nature" of the soil is subdued by many plowings and trappings of the tame cattle; even so, when land has been stripped of woods and worn by farm crops, it is hard to recover it with forest. Just here the aid of science is needed. Here is work for the

schools of forestry that have done so much for France and Germany. The forest restoration of Europe is due to science, and is accomplished by men trained for the purpose.

Again the more regularly distributed rainfall of western Europe, especially in the north and Baltic countries, is more favorable to the restoration of forests than in America generally, though in some parts of Europe the soil is so much worn out it is almost impossible to make trees grow. Indeed, all over Europe, and especially east and south of the Mediterranean, and over most of the older settled portions of the Eastern Hemisphere, it seems to have been the especial mission of the Aryan race to destroy and remove the forests from the face of the earth.

In the lumber yards of England, Scotland, Hamburg, Bremen, Antwerp and France I saw much of the timber from America. Our forests are drawn upon to supply the waste of centuries in the old world. It is time we began to think of husbanding our own resources.

THE ONTARIO FOREST RESERVATION.

A most important movement in the direction of forest preservation is now being made by the Ontario Government. A large tract of country is about to be set aside as a forest reservation. The place suggested is principally in the Nipissing territory, and it is supposed will embody twenty or more townships. It is well calculated for the purpose, being largely interspersed with small lakes and numerous streams, thus forming reservoirs of water to feed the rivers flowing into the greater lakes to the south and north, giving moisture and fertility to the lands through which they pass, the great factor in agricultural success. It may be remarked here that the passage of water, or rather the vapor of water, through the ground is the means by which all food is conveyed to plants. The rain falling on the earth assisted by numerous little rivulets under the surface is perpetually drawn again into the atmosphere by the heat of the sun, and in its passage among the plant roots, carries their necessary food to them. This again points out the value of lines of trees, especially evergreens, which prevent the too rapid progress of the wind over the earth, and keeps the ground after a shower much longer in a moist and growing condition. This, namely, the acting as a feeder of rivers and streams, will form one of the most useful features of the reservation in question.

This portion of country possesses highly diversified scenery. There are many ranges of lofty hills, many broad and pleasant valleys and many rapid streams. Here and there is many a stretch of barren and rocky land, now covered with trees, which, with a little care can be preserved. In such a reservation they can be preserved, as there will be rangers in charge whose duty it will be to attend to these and many other matters. It may be noticed that this will not take any land from the farmer. The ground is generally unfit for agriculture, owing to the poor quality of the soil. It is by no means such land as the southern portion of Ontario possesses. Here the foundation is limestone, but to the north we find the Laurentian formation, and the rocks of everlasting granite. The soil covering this is light, poor, and often of a peaty nature. It will, if well cared for, yield good crops of grass; but it is not needed for that purpose, there being vast areas, yet unsettled, adjoining, equally well adapted for the purpose.

There is yet another point in which reservation will be extremely valuable, it will form a place where many wild animals and many birds which it is desirable to preserve will find a comparatively secure resting place. Some of these will of course now and then be destroyed, but the complete depopulation of the forests, which occur when no means of preservation are taken, will be prevented. It will, to a certain extent, form a breeding ground which will supply the rest of Ontario with game. For instance, there numerous creeks and ponds are the favorite resort, in fact the very home, of the beaver, one of our most valuable fur-bearing animals. Such a place will in time form a most agreeable resort for those who go to the country, not to destroy life but to enjoy nature. It can be seen there in all its various aspects. I have never known elsewhere such storms as those that rage among our northern woods, nor such a calm as afterwards settles over the whole

landscape. When up there one can understand the feeling which possessed the old hunter who, hearing that a settler was clearing within fifty miles of him, moved his own camp fifty miles further back, for fear he should be crowded and not be able to breathe comfortably.

The measure of preserving a large portion of forest or prairie land is now being largely adopted in North America; the United States have laid aside, in their western territories, several large parks; the Ottawa government have acted in a similar manner in laying aside a large park on the Rocky Mountains. That which is now being planned by the Ontario government will be of great extent and of great value to the country. Various states and municipalities are also making great endeavors in this direction, the state of New York, already possessing a great tract in the Adirondack mountains, is trying greatly to enlarge it by purchase; it was full time, for the destruction of the forests on these mountains was lessening the volume of water in the Hudson, and would in time have greatly impaired its value for commercial purposes. This effect is frequent and well known to those who have studied the matter. I have been shown by residents along the shores of our lakes various places where schooners drawing ten feet of water were formerly built, which now are but small creeks scarcely two feet wide.

It is of great importance, both from agricultural and commercial points of view, to preserve numbers of trees on the higher lands. There are in settled Ontario several watersheds, both ridges and hills, on and near which I should like to see the present bonus for tree planting doubled. This measure would, it appears to me, result in a largely increased number of trees being yearly planted in those localities, and be of great benefit to the agricultural lands on which water pours from their greater elevation. For, as has often been repeated, a wooded country, or even only a wood lot, in an elevated position, will hold moisture and gradually part with it to the benefit of the surrounding lands; while, from a cleared height, it would merely pass away in a torrent, of little use, and indeed often of injury to the farmer.

These forest reservations, will in the future, be the subject of grateful remembrance on the part of those who shall then possess the land; and those legislators of our present day who shall be instrumental in securing to our successors such undoubted benefits, will receive the praise rightly due to their efforts. It may well be also, that the value of proper forestry management will by that time be so much better appreciated, owing to its results being observed, as to cause the preservation of many woods, and the planting of many more. For nothing is more certain than that it is to planting we must look for the ultimate maintenance of sufficient forest, in localities where we have largely destroyed the original trees.

Another, and a very great, value forest reservations will give, will be the opportunity of trying experiments in planting and preserving trees. It might well be that such trials would enable us in time to restore much of our ancient forest. It is true that it would be a matter of time, but the land would always be the more valuable for the trees, as, if fire can be kept away the owner could always reckon, in a certain time, on a very valuable return. The old forest only gave us a good tree here and there; but in a planted wood every tree is of a good variety, and placed in such a manner as to secure a full return from the acreage employed, and also to give all possible ease of access when it is desirable to cut.

It is to be hoped that the commissioners who are to examine the ground and report on the matter, will be able to give in a full report in time to allow action to be taken by the next session of the Provincial Parliament, so as to secure for all time to come the benefits which are to some extent above described. Other legislatures have proposed action in similar matters; but some of them, though possessing ample means, have performed much less than they proposed. It does not answer, in such a matter, to lose quarter centuries. No one can make certain of the future; but there is all reasonable probability, taking into consideration the class of men who have for many years so well managed the interests of Ontario, that good progress will be made, and efficient results obtained, in the securing and management of the new forest reservation.

STATE ENCOURAGEMENT TO FORESTRY.

It has often been proposed and advocated that legislatures should, either by establishing nurseries or buying trees, make a large yearly gratuitous distribution of young saplings fit for planting to those farmers and others who are likely to make good use of them. In Canada we are neither so rich as our neighbors, nor have we so many large landed proprietors possessed of such enthusiasm in tree planting, as they have the good fortune to retain within their borders. It will be seen, by the extract annexed, how largely American legislatures encouraged forestry, and how readily, in many instances, the encouragement given is taken advantage of. What will be particularly noticed is that many new and valuable trees are being cultivated, most of them apparently possessing qualities superior to those hitherto in general use. Large plantations of trees are now common in many of the states, and foremen are hired on farms especially with reference to their capability in tree management. In Kansas I saw several plantations each a mile square, and in other states many valuable blocks of timber, planted twenty years ago, now tall trees. On the Massachusetts coast they cover the light sandy land with fine forests, and find it pay, though the wood is only used for the roughest purposes, such as box-making. This is done by sowing, not by planting.

The article which follows, taken from *Garden and Forest*, is from the pen of F. M. Gallagher, Esq., Montecito, Cal. It would, of course, be better if such statements were obtainable from our own press. But few experiments, and none on a large scale, are made in Canada. In that case, the next best resource is to observe, and if possible, profit by what our neighbors are doing. The trees in which they experiment, spoken of here, are of course those suited to California; but their example could be followed here with those fitted for a Canadian climate:

FOREST EXPERIMENT STATION AT SANTA MONICA.

In no other state of the Union are questions pertaining to forestry of more profound importance than in California. The immense bodies of timbered land in the north, the comparative treelessness of the south, and the supreme need of preserving every drop of water in all parts of the state for irrigation, give an unusual interest to every effort directed either toward the preservation of the forests we already have or to the plantation of new ones.

The work of the State Board of Forestry, though hampered by an insufficient appropriation of funds, and somewhat, also, by the usual considerations of practical politics, represents, nevertheless, a very creditable beginning of a movement which has already shown the wisdom and foresight of those who inaugurated it, and is sure to have a wide influence on the future development of the state.

One of the best-directed and most promising undertakings of the Board has been the establishment of two experiment stations, one at Chico in the north, upon land donated by ex-Governor Bidwell; the other in the south at Santa Monica, upon land given by Senator Jones, of Nevada, and his partner who own together some 40,000 acres of beautiful and fertile land between Los Angeles and the sea. This station comprises twelve acres, situated within half a mile of the Pacific, and includes a narrow valley with its sturdy little stream, and two benches of a few acres each, which form steps to the level table-land above, and give a desirable variety of soil and exposure. The work here is, of course, turned more particularly to the growing of such trees as are expected to be specially adapted to the southern part of the state. A large proportion of the trees are of Australian origin, and interest is centered chiefly in the two wonderful genera, *Eucalyptus* and *Acacia*, the Gums and Wattles, as they are known in Australia.

It was recently predicted by an eminent German forester, Dr. H. Mayr (*Garden and Forest*, vol. iii., p. 445), that in fifty years it would be inconceivable that southern California was once treeless. "Amid magnificent forests," said he, "of Australian *Eucalyptus* and *Acacias*, the visitor will be inclined to doubt that he is really in America."

Many thousand young seedlings are grown annually for gratuitous distribution, and the grounds of the station are being filled with specimen trees and with small plantations set out in various ways to test the practical value of the different methods of planting and culture. Of Gums there are some forty species represented by trees from two to three years old, and from five to thirty feet in height, which are now at the most interesting stage of growth. Eucalypts as a rule have a great diversity of appearance during the first two or three years of their life. The leaves and habit change as the trees grow older, and assume, to a large extent, the same general character of long, pendant, lanceolate, and more or less glaucous leaves and drooping branches, so that in old trees it is often very difficult to determine the species except by the flowers and seed-vessels. Many of the trees at Santa Monica now have both their youthful and mature forms of foliage, and many are beginning to flower—a precocity certainly remarkable in trees which grow to such an immense size.

The foremost of the Eucalypti as regards the number grown in California is the *E. globulus*. The cultivation of this species has passed the experimental stage, since it is grown by nurserymen by millions annually, and it is planted throughout the state, sometimes in groves quite large enough to be called forests. The extremely rapid growth of this tree, and the high price of fuel, make it a profitable investment for planting. A tree of this species, recently cut at Santa Barbara, three years and nine months old from the seed, measured forty-three feet ten inches in height and eight and three-quarter inches in diameter at the butt. This tree was not an isolated specimen, but was in the midst of a grove planted eight feet apart each way.

The Red Gum (*E. rostrata*), is also established in California. Its growth is less rapid than that of the Blue Gum (*E. globulus*), but its lumber is more valuable. The wood is stronger, more easily worked, and more durable for such uses as posts, telegraph poles, railroad ties, and especially for piles, since it is not attacked by the Teredo.

Aside from these two species, but few of the many excellent Eucalypts were generally known here until brought into popular notice by the efforts of the State Board of Forestry. There have now been distributed through the state from Santa Monica a large number of new species worthy of attention for the different qualities they possess. Specimens of these at the station are already large enough to show indications of their value, and to give some useful hints to those desiring to plant.

Among the more noteworthy is the Sugar Gum (*E. corynocalyx*), a tree of rapid growth and handsome appearance. It is more umbrageous than most Gums, and produces a hard, strong wood, remarkable for its durability under ground. The chief merit of this tree, however, is its adaptability to the most arid localities. It has been recommended by Baron Von Müller for planting in the Algerian regions of the Sahara, and has succeeded well in Southern California on dry and rocky foot hills impossible to cultivate. A specimen of this species grew during its second year from planting from eight and a half to nineteen feet in height.

E. viminalis, the Manna Gum, is one of the hardiest species, and has been extensively distributed to the cooler districts of the state. It will stand for a short time without injury, according to Monsieur Naudin, a temperature as low as fourteen degrees Fahrenheit. Though a shapely tree for avenue planting, and almost as rapid in growth as *E. globulus*, its wood is softer and less valuable than that of many other species. The custom is almost universal among the nurserymen here to sell this tree as *E. rostrata*.

E. marginata, the Yarrah, which is famous for the resistance of its wood to attacks of the Teredo when used for piling, and which forms such extensive and valuable forests in west Australia, has proved of rather slow growth at Santa Monica. Its increase in height does not exceed two or three feet in a year.

The station has a number of fine specimens of *E. amygdalina* and *E. diversicolor*, trees which, in their native soil, according to Von Müller, sometimes grow to a height of over four hundred feet, overtopping, perhaps, our giant Sequoias.

The handsomest of all the species at Santa Monica, at least in their present stage of growth, is *E. polyanthema*, or Gray Box. Its upright form and dense foliage at once

distinguish it, but its chief beauty is in the delicate pearly gray color of the leaves which, in the young growth, is almost lavender. On young trees the leaves are nearly round, and are gracefully curved. While not growing so rapidly as some others of the genus, the Gray Box produces very valuable timber, and has shown a capacity to resist extreme drouth.

Next in order of interest to the experiments with the Gums are those which have been made with the Wattles or *Acacias*. The Black Wattle (*Acacia decurrens*) is a specially noteworthy tree, as remarkable for its wonderful rapidity of growth as for its extraordinary beauty. But its chief claim to attention is in the value of the bark for tanning leather. The Golden Wattle (*A. pycnantha*), though not growing quite as fast, produces a bark still richer in tanning qualities. Thoroughly dried specimens have frequently yielded to a chemical test over thirty-six per cent. of tannic acid. These trees promise to give to California a plentiful supply of tanning material. The bark of the Chestnut Oak already commands \$16 or \$17 per cord in San Francisco, and the supply has yearly to be obtained from less accessible places. The tanners of the Coast appreciate the importance of the subject, and have shown considerable interest in the experiments of the board looking toward the more extensive introduction of the Wattles. In Australia and New Zealand the cultivation of these trees is rapidly spreading, some plantations containing as many as 3,000 acres, and apparently giving satisfactory returns. The trees are ready to strip when from five to seven years old, and an acre containing 1,000 trees is expected to yield over five tons of bark, valued at \$35 or \$40 per ton. The wood of the Wattles is used in Australia for spokes, staves, etc., and it makes excellent fuel.

Both these trees are very floriferous, and when in flower are masses of yellow bloom, the fragrant little golden balls hanging in innumerable racemes from every part of the trees. The Black Wattle seems to possess about the same degree of hardness as *Eucalyptus globulus*. The Golden Wattle is more tender, but will do well in localities of extreme aridity, and is contented with a very poor soil. These trees being somewhat difficult to transplant, the experiment has been tried of planting the seed in cuttings of bamboo or cane four or five inches long, set up on end and filled with earth. One or two seeds are planted in each tube. When the trees are six or eight inches high they are easily transferred to the field, tube and all, without disturbing the roots, and the cuttings of bamboo are left to decay.

Another noteworthy tree is the Blackwood (*A. melanoxylon*). Its symmetrical shape, dense foliage and abundance of flowers make it a very desirable tree for avenue planting, while the wood, much resembling that of the Black Walnut, is highly esteemed in Australia for cabinet making. The Blackwood, like the Golden Wattle, belongs to the wonderful *phyllodineous Acacias*, no less interesting morphologically than they are curious to the most careless observer. The leaves on the young tree for the first few months are soft, feathery and bipinnate. The leaf stalks soon begin to broaden and lengthen out, until at last they become the somewhat stiff, leathery *phyllodia* which form the foliage of the mature tree, though sometimes retaining upon their tips, for two or three years, remnants of the bipinnate leaves of their youth.

These are a few of the more important of the many interesting trees which are being brought to the attention of California planters by the experiments at Santa Monica. The station is in charge of Mr. Wm. S. Lyon, an accomplished botanist and enthusiastic tester of trees, whose pen has, moreover, done much to bring about a proper public sentiment in regard to all questions relating to the forestry interests of the state.

RAPID DESTRUCTION OF WOODS IN ONTARIO.

In the first columns of this report will be found statements from the oldest counties in Ontario concerning the amount of forest remaining therein. In addition to much personal observation, these were obtained as follows: Leading men in various counties were

asked to suggest the names of persons likely to be best informed on the matter. These were applied to and their statements given in this report. These statements will not always agree with the ordinary municipal returns, as these latter are generally based on the assessors' reports, in which much land is set down as forest because it is not used for agriculture, although there may be little or no good timber upon it. Here we have the opinion of men of standing from each county, often life-long residents therein and no doubt capable of giving a good general idea on the subject.

It will be perhaps a disagreeable surprise to many of my readers to find that the stock of timber in many of the counties has diminished to such a small proportion. I have not myself been surprised by it, as during the last ten years I have frequently pointed out that such would be the necessary result of the course which we were pursuing. The causes of this rapid destruction of forest timber are various, and one of the chief of them may be mentioned. In the first place much timber is cut and sold during the winter for firewood, both for the sake of the money it will bring and to provide employment during the dull season of the year. It is not that other firewood could not be easily procured, as there is generally much dead and lying timber and mature trees which might as well be cut down and from which an ample supply might be obtained. But this is not the method taken. The chopper generally goes where he can quickest cut his cord of wood, and I have repeatedly seen a fine young bush of beech and maple scarcely nine inches through on the stump thus destroyed.

This method of clearing is not in the end valuable to agriculture. It enlarges the amount of cleared land, but it does not by any means enlarge the crops obtained. The limit of value in plowed land is the amount which the farmer's resources will enable him to keep in good heart, while as to pasture and meadow an expanse greater than can be kept in good grass and free from weeds is generally more of an injury than a benefit. These remarks do not of course apply to bush farming, where we merely clear the timber and drag in the seed. But the woodman only clears the way for the farmer who follows, and it is he who, now that our forest resources are rapidly dwindling, should endeavor to leave a reasonable proportion of timber on his land.

The uses of wood to the farmer are so various and its possession so necessary that it is full time we should endeavor to preserve it, but the habit so long common to Canadians of clearing the forest before them in every direction has deadened our feeling to the value of what we were destroying. The rapid disappearance of the forest, however, is compelling a change in public opinion. It is to be hoped that this change will be immediate and its results as lasting and valuable as the diminished amount of forest yet at our disposal will permit.

MISCELLANEOUS EXTRACTS.

At the late meeting of the American Forestry Association the committee on Arbor Day reported that the day was now officially recognised and observed in thirty-seven states and territories.

According to a report of the United States Minister at Stockholm, the greatest source of revenue to the kingdom of Sweden is its forests. That portion of the country which is called the Norland is still, for the most part, covered with extensive forests largely composed of pine and spruce.

Among the resolutions passed at the late meeting of the American Forestry Association was one urging upon superintendents of school in the various states to require that the high schools shall make forestry, in connection with botany, a subject of instruction, and it was further resolved that whereas the interests of agriculture are intimately dependent upon proper forest-conditions, and whereas the Government of the United States has lately made large additional appropriations to agricultural colleges and experiment stations, it is therefore earnestly recommended that forestry be made a part of the curriculum in the agricultural colleges and experiment work in the various stations.

In a letter to the American Forestry Association, ex-Senator Edmunds writes: "The subject of forestry is of immense importance to the future welfare of all our countrymen, as well in Vermont as in the arid regions of our one country. I have seen in Europe much of the remediless evils of stripping the hills and mountain-sides of their forests great or small, and I have seen in our temperate and well-watered climate of Vermont how great has been the loss from reckless timber-cutting. The devastations of a dozen years can hardly be repaired in half a century, and so every energy of reason and persuasion ought to be brought to bear upon the public intelligence to avert the evils that so seriously threaten large parts of the republic from the destruction of the forests."

"There is very little forest left in this state," recently said the *Pittsburg Dispatch*, "which is worth anything for lumber, and meantime the railways are consuming all the hardwood large enough to make a tie, so that there is no prospect of a renewal of our hardwood timber in a century, and the pine and other persistents do not readily reclothe the wastes. But worse than the loss of timber, for which substitutes may be found, is the fact that since the denudation of the forests our climate has become so uncertain that, even with the aid of the Signal Service, no business calculations can be based on the weather, and birds and animals have not yet acquired new instinct such as will enable them to serve us as barometers. Even the hoot-owl misses it as often as the Weather Bureau."

A writer in the *Gardener's Magazine*, London, speaks of the facility which the Douglas spruce manifests for accommodating itself to various soils in Great Britain. Some of the best specimens of the tree are found in rich loam or alluvium and in sheltered situations. At Eastnor Castle it drives its roots down through the fissures of the rocks, which are just below the surface soil, and flourishes well on the moisture there found for its support. It grows with great vigor among the slate rocks of North Wales, even up to the very summits of the hills, and seems well adapted to elevated situations where even spruce will not grow. In favored situations its growth is very rapid in Great Britain, and trees planted only thirty years have in that time reached a height of seventy feet, with a proportionate bulk of stem.

In the current number of *Meehan's Monthly* it is stated that the Girard estate has been making small forest-plantations in an experimental way to see if it was practicable to grow timber in the coal regions, where nearly every stick has been cut away for props and various other uses connected with mining, so that now almost every piece of plank used there has to be brought from a distance. Eight years ago seedling English larches and Scotch pines, one year old, were planted in furrows driven through the underbrush which was growing up where old forests had been cut away. The larches now average from seventeen to eighteen feet high, and are noticeably healthy. The larch is a mountain-tree, and thrives in comparatively poor soil, and as these plantings are 1,500 feet above the sea-level the tree has something of its natural conditions. The vigor of the trees shows that they appreciate this position.

COVERING FOR TREE WOUNDS.—It often happens that, either by intention as in pruning, or by accident, trees are wounded in various ways. A common practice is to cover large wounds with coal tar, but this is objected to by some as injurious to the tree. Experiments go to show, however, that its use in covering large wounds is not injurious; but that, on the contrary, a callus readily forms under the tar, on the edges of the wound, and that the wounded part is thus protected from decay. There is, nevertheless, another objection; for if the tar be applied a little too thick, the sun melts it and it runs down on the bark of the tree. This can be obviated by mixing and stirring, and thus incorporating with the tar about three or four times its weight of powdered slate, known as slate flour—the mixture being known as plastic slate, and used for roofing purposes. It is easily applied with an old knife or flat stick, and though it hardens on the surface, it remains soft and elastic underneath.



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